SAMPLING AND ANALYSIS PLAN (SAP) FOR AIR SAMPLING ACTIVITIES AT THE BRIDGETON SANITARY LANDFILL IN BRIDGETON, MISSOURI

Prepared for:
Missouri Department of Natural Resources
1730 East Elm Street
Jefferson City, Missouri 65102

Prepared by:
Soil Water Air Protection Enterprise
1640 Fifth Street, Suite 204
Santa Monica, CA 90401

April 2013

Technical Consultation, Data Analysis and Litigation Support for the Environment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS

AAC	Atmospheric Analysis and Consulting, Inc. (Ventura, California)
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
COCs	Chemicals of Concern
D/T	Dilution to Threshold
EMEGs	Environmental Media Exposure Guides
FML	flexible membrane liner
HASP	Health and Safety Plan
H2S	hydrogen sulfide
LEL	Lower Explosive Limit (of methane)
MDNR	Missouri Department of Natural Resources
MRL	Minimum Risk Level (ATSDR health-risk based screening level)
Nasal Ranger	Nasal Ranger® Field Olfactometer
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PAHs	polynuclear aromatic hydrocarbons
PEL	Permissible Exposure Limit
PID	photo-ionization detector
ppb	parts per billion
ppm	parts per million
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCPs	reinforced concrete pipes
RSL	Regional Screening Level (U.S. EPA health-risk based screening level)
SKC	SKC, Inc. (Eighty Four, Pennsylvania)
Site	the Bridgeton Sanitary Landfill in Bridgeton, Missouri
Stantec	Stantec Consulting Services Inc.
St. Croix	St. Croix Sensory, Inc. (Stillwater, Minnesota)
SWAPE	Soil / Water / Air Protection Enterprise
U.S. EPA	United States Environmental Protection Agency
VOCs	volatile organic compounds

SUMMARY OF PROJECT PERSONNEL

SWAPE Personnel Contact Information:

SWAPE Main Office in Santa Monica, CA
Paul Rosenfeld, Ph.D., Project Manager
Rob Hesse, P.G.

Subcontractor Personnel Contact Information:
Subcontractor Services Office in St. Louis
John Blank, Subcontractor
Jeff Miller, Subcontractor
Michael Kye, Subcontractor

Eric Winegar, Ph.D., Technical Consultant

MDNR Contact Information:
Brenda Ardrey, MDNR
Dan Norris, MDNR

1. INTRODUCTION

This Sampling and Analysis Plan ("SAP") by Soil / Water / Air Protection Enterprise ("SWAPE") presents a generalized scope of work for conducting environmental air sampling and air monitoring activities at and near the Bridgeton Sanitary Landfill in Bridgeton, Missouri (the "Site"). These activities will be conducted to support the Missouri Department of Natural Resources ("MDNR") concerning their ongoing regulatory compliance activities for the Site. The proposed sampling and analysis activities will be conducted by SWAPE employees and subcontractors ("Project Personnel").

The field activities that are proposed for this project shall strictly consist of non-invasive work such as ambient air sampling and air monitoring operations. This SAP has been written to provide Project Personnel with a guidance document for performing limited environmental air sampling and air monitoring operations at the Site and in the surrounding community. Project Personnel will conduct the proposed work activities under the direction of the Project Manager and MDNR representatives as directed. Any deviations from the procedures addressed in this SAP will be recorded and appropriate notifications will be made to the MDNR.

1.1. SITE DESCRIPTION

The Site is a solid waste landfill that operated from approximately 1985 to 2004.[1] The landfill encompasses approximately 52 acres with a waste mass located approximately 240 feet below the ground surface ("bgs") and a thickness of approximately 320 feet. The waste is located in two areas known as the North and South Quarries. The Bridgeton Sanitary Landfill lies within the boundaries of the West Lake Landfill, which is described in more detail below. Maps depicting the geographic features of the Bridgeton Sanitary Landfill are presented in **Attachment A**.

Since late 2010, the Site has experienced various problems such as elevated subsurface temperatures, subsurface smoldering, rapid settlement, and increased odors associated with landfill emissions.[2] These events have prompted the MDNR to conduct various investigations of the Site, including air monitoring and sampling activities at and around the landfill. Air monitoring and sampling activities have been conducted by landfill contractors and MDNR personnel. To address the odor issue, the Bridgeton Sanitary Landfill operator is conducting various construction activities and corrective actions at the Site to reduce the odorous emissions.

---

[1] Overview of Bridgeton Sanitary Landfill - West Lake Landfill, website page. Missouri Department of Natural Resources >> Division of Environmental Quality. Accessed on April 4, 2013.
[2] *Ibid.*

Some of the construction activities that have been undertaken or are ongoing have caused increased emissions and odors in the community surrounding the landfill.[3]

1.2. ENVIRONMENTAL CONDITIONS AND PREVIOUS INVESTIGATIONS

The earliest comprehensive study of the landfill emissions was conducted in August 2012. On August 16 and 17, 2012, representatives from Stantec Consulting Services Inc. ("Stantec"), a contractor of Republic Services, Inc., coordinated with MDNR staff to collect samples of landfill gas from several locations under the flexible membrane liner ("FML") at the landfill. Stantec also collected ambient air samples from onsite, downwind, and upwind of the designated area of concern at the Site. The results of this air sampling assessment was reported by Stantec in October 2012.[4]

The August 2012 air sampling assessment by Stantec was designed to determine concentrations of eleven (11) different classes of compounds. Air samples were analyzed for volatile organic compounds ("VOCs"), reduced sulfur compounds, carboxylic acids, amines, ammonia, aldehydes, dioxins/furans, polynuclear aromatic hydrocarbons ("PAHs"), hydrogen cyanide, mercury compounds, and fixed gases (e.g., (hydrogen, methane, carbon monoxide, and carbon dioxide). A wide variety of chemical substances have been detected in landfill gas beneath the FML and in ambient air at the Site and at off-site locations. Additional air sampling activities have been conducted at and in the area of the Site by the MDNR.[5] These sampling activities have indicated that VOCs, aldehydes, reduced sulfur compounds, hydrogen sulfide ("H2S"), and other contaminants have been present in ambient air at elevated concentrations. The results of previous air quality sampling indicates that VOCs, acetaldehyde, dimethyl sulfide, H2S, and other contaminants are present in the ambient air at low parts per billion ("ppb") range.

The air sampling activities that will be undertaken by Project Personnel are concerned with the collection of air samples for assessment of emissions of airborne pollutants from the Bridgeton Sanitary Landfill site. Air quality samples will be collected at off-site locations in the community immediately surrounding the Site as well as at the Site. Project Personnel may be exposed to low ambient air concentrations of contaminants in the ranges detected during previous sampling events. Project Personnel conducting work described in this SAP will reference the project Health and Safety Plan ("HASP") that has been developed specifically for the planned air monitoring and sampling activities.

---

[3] Odors - Bridgeton Sanitary Landfill, website page. Missouri Department of Natural Resources >> Solid Waste Management Program. Accessed on April 4, 2013.
[4] Bridgeton Landfill Air and Landfill Gas Sampling, August 2012: Summary of Findings. Stantec Consulting Services, Inc. October 19, 2012.
[5] Air Sampling - Bridgeton Sanitary Landfill, website page. Missouri Department of Natural Resources >> Solid Waste Management Program. Accessed on April 4, 2013.

2. WORK DESCRIPTION

SWAPE will be responsible for the air monitoring and sampling plan, air sample collection, analysis and summary of laboratory data, and preparation and submittal of documents and data transmittal reports to the MDNR. Subcontractors will assist SWAPE in the collection of air monitoring data and air samples as well as some data reduction and reporting tasks. Air monitoring activities will consist of screening surveys to measure air quality around the Site using direct-reading instruments. Air sampling activities will consist of the collection of samples of air using specific sampling procedures, equipment, and laboratory analytical testing of air samples. The specific air monitoring and sampling activities and laboratory services are described in **Sections 5 through 7**.

The planned activities can be divided into several categories of routine air monitoring and sampling tasks. These activities will consist of Daily Monitoring Events, Weekly Sampling Events, Immediate Sampling Events, and Comprehensive Sampling Events. Each of these air monitoring and sampling activities are briefly described below.

Daily Monitoring Events

Daily Monitoring Events will consist of air monitoring activities using direct-reading instruments. In general, these activities will be conducted off-site near the perimeter of the Site or within the general vicinity of the Site at locations in the surrounding community. This monitoring activity will be conducted by a subcontractor to SWAPE. Air monitoring will be conducted by driving around the Site and stopping to collect ambient air measurements. This work will be conducted early morning to daytime to evening hours, to be determined.

Weekly Sampling Events

A limited set of off-site air sampling activities will be conducted during Weekly Sampling Events. These activities are planned to occur approximately every six (6) days on a schedule to be determined by MDNR. Weekly Sampling Events will be performed by a subcontractor to SWAPE. For each of these Weekly Sampling Events, Project Personnel will establish approximately four (4) air sampling stations at locations upwind and downwind of the Site. Air sampling equipment will be set-up and deployed at these air sampling locations, where samples will be collected over a period of approximately four (4) hours. This work will be conducted early morning to daytime to evening hours, to be determined. Air sampling stations will consist of the set-up of a lockable metal enclosure that will contain air sampling equipment. Project Personnel will deploy and monitor the air sampling stations on an as needed basis.

Immediate Sampling Events

In the event of an unforeseen incident at the Site or in response to construction activities at the Bridgeton Sanitary Landfill, the MDNR may request an Immediate Sampling Event to occur. This activity will be similar to a Weekly Sampling Event and will be performed by a subcontractor to SWAPE. For each of these Immediate Sampling Events, Project Personnel will establish approximately four (4) monitoring stations at locations upwind and downwind of the Site. This work will be conducted early morning to daytime to evening hours, to be determined.

Comprehensive Sampling Events

Project Personnel will conduct at least one, and possibly two, Comprehensive Sampling Events as part of this project. A Comprehensive Sampling Event will consist of approximately three days of off-site and on-site air monitoring and air sampling activities. These sampling activities will be performed by SWAPE and subcontractor Project Personnel in coordination with MDNR.

Off-site sampling will consist of establishing approximately six (6) air sampling stations at locations upwind and downwind of the Site. Air sampling equipment will be set-up and deployed at these six (6) air sampling locations, where samples will be collected over a period of approximately four (4) hours. This work will be conducted early morning to daytime to evening hours, to be determined.

Ambient air sampling stations will also be established on-site at the Bridgeton Sanitary Landfill - South Quarry Area or other areas, to be determined. These ambient air sampling locations will be sampled for a period of approximately four (4) hours. During the course of these sampling activities, Project Personnel will typically set-up and monitor / secure these locations continuously for the four (4) hours sampling duration. At some locations, continuous observation may not be necessary, such as at the on-site locations.

Project Personnel will also coordinate with MDNR to collect air samples from the landfill gas source under the FML. Project Personnel will coordinate with the MDNR and a designated on-site landfill representative to connect air sampling equipment and devices (e.g., tubes) to in-place sampling manifolds and sampling ports that are fixed into the landfill FML. The time period for performing sampling at landfill gas source locations is expected to take several hours.

3. PROJECT COORDINATION AND SCHEDULE

3.1. KEY PERSONNEL

Project Manager

The Project Manager, Paul Rosenfeld, Ph.D., is responsible for directing and controlling the performance of all on-site and off-site air monitoring and air sampling activities. Dr. Rosenfeld will coordinate with subcontractor personnel to conduct specific field activities in accordance with the planned scope of work. Dr. Rosenfeld will also coordinate with MDNR to ensure that the project objectives are being met and that appropriate communications are being made.

Local Field Services Manager

John Blank will serve as the local project coordinator and field services supervisor. John Blank will manage the air monitoring and sampling services for the Daily and Weekly Sampling Events described in Section 2 and in additional detail below. Mr. Blank may assign and oversee additional staff for the project on an as needed basis. All field services provided by Mr. Blank and other assigned subcontractor personnel will be conducted under the direction of the Project Manager, Dr. Paul Rosenfeld.

MDNR Coordinator

Dan Norris will be the MDNR sampling coordinator for this project and will be providing communications and coordination with the landfill operator and representatives at the Site, as well as with other MDNR staff and property owners located in the vicinity of the Site. Mr. Norris will serve as the primary contact for MDNR regarding technical aspects of the planned air quality monitoring and sampling activities to be performed by SWAPE and subcontractor personnel.

3.2. LINES OF COMMUNICATION

All Project Personnel, including subcontractors will report individually to the Project Manager, Dr. Paul Rosenfeld. For the proposed air monitoring and air sampling activities, all field forms, location-specific records, and data generated by individual Project Personnel (e.g., field notes, Chain of Custody forms, etc.) will be delivered directly to the Project Manager. Laboratories to be used for analytical testing of air samples will also deliver electronic reports and data deliverables to the Project Manager in accordance with the methods identified in the project QAPP document. The Project Manager will ensure that all appropriate data deliverables and summary reports are prepared and submitted to MDNR.

3.3. HEALTH AND SAFETY PLAN SUMMARY

A project Health and Safety Plan (HASP) has been developed to address health and safety issues relating to site-specific hazards that have been identified for the proposed air quality monitoring and sampling activities. The project HASP discusses hazards such as slips, trips, and falls; heat and cold stress; vehicle traffic hazards; air monitoring; personal protective equipment; decontamination; and other safety and health issues applicable to the proposed sampling activities. All Project Personnel are required to adhere to the HASP while conducting air monitoring and sampling activities.

3.4. QUALITY ASSURANCE PROJECT PLAN SUMMARY

A Quality Assurance Project Plan ("QAPP") has been prepared for this project and provides procedures to ensure that monitoring and sampling activities conducted as part of the proposed work activities meet quality performance goals. Quality Assurance/Quality Control ("QA/QC") is fundamental to the QAPP. The QAPP is utilized to assess and verify that the air monitoring and air sampling, testing, and analysis activities are consistent with applicable guidance and foundational QA/QC objectives, including representativeness, precision, accuracy, completeness, and comparability.

4. SAMPLING SCHEDULE AND METHODS

The air monitoring and air sampling activities will be performed during early morning hours, daytime hours, and evening hours, to be determined. Most of the air monitoring and sampling activities will be conducted at off-site locations. Some air sampling activities will be conducted on-site at the Bridgeton Sanitary Landfill.

The Project Manager will coordinate the air monitoring and air sampling activities with the MDNR and subcontractor personnel. Based on the sampling program discussed with MDNR at the time of writing of this SAP, Project Personnel will conduct at least one, and possibly two, Comprehensive Sampling Events as part of this project. The first Comprehensive Sampling Event is scheduled to occur in mid-April 2013. Daily and Weekly Sampling Events will occur more frequently and will be performed by a subcontractor to SWAPE. There are planned to be approximately 62 Daily Sampling Events and 10 Weekly Sampling Events for this project.

The parameters to be monitored and/or sampled will vary for each type of sampling event. Daily Sampling Events will consist of air monitoring measurements using direct-reading instruments. Air monitoring measurements will include screening surveys for odors, VOCs (i.e., benzene), and H2S. The monitoring equipment that will be used for air quality screening during Daily Sampling Events is discussed in **Section 5**. MDNR may coordinate with the landfill operator to conduct some on-site ambient air monitoring as part of Daily Sampling Events.

Weekly and Immediate Sampling Events will include the collection of air samples for analysis of aldehydes, VOCs, and reduced sulfur compounds. Weekly Events will be conducted approximately every six (6) days on a routine schedule. Immediate Sampling Events are anticipated to be conducted infrequently. Immediate Sampling will be coordinated by MDNR to coincide with landfill construction activities. The parameters and associated laboratory analytical testing methods that will be included in the sampling program are presented in **Table 1**.

The first Comprehensive Sampling Event will include analyses of air samples for: aldehydes, amines, ammonia, carboxylic acids, hydrogen chloride, hydrogen cyanide, mercury (elemental), sulfur dioxide, dioxins/furans, PAH's, VOC's, reduced sulfur compounds, and fixed gases. In addition, air samples will also be collected for odor evaluation. The sampling equipment that will be used for air quality sampling events is discussed in **Section 6**.

5. AIR MONITORING PROCEDURES

Real-time air monitoring will be performed at off-site locations surrounding the Site. Air monitoring will be conducted by a subcontractor to SWAPE using direct-reading instruments. Various instruments will be utilized to monitor ambient air levels of odors, VOCs (i.e., benzene), and H2S. Air monitoring will be conducted using instruments purchased specifically for this air quality assessment project as well as devices already maintained for use at the Site by the MDNR.

During the course of a typical air monitoring event, Project Personnel will document their activities on various project field forms that will be utilized throughout the course of the project. Project Personnel will document daily work activities, the results of monitoring instrument calibration(s), observations during air monitoring events, monitoring locations and readings from direct-reading instruments, and any other information, as necessary. Field forms that will be used during the course of this project are presented in **Attachment B**.

5.1. MONITORING METHODS

Odors will be monitored using a Nasal Ranger® Field Olfactometer ("Nasal Ranger"). The Nasal Ranger is a hand-held field olfactometer used for measuring and quantifying odor strength in the ambient air. The Nasal Ranger directly measures and quantifies odor strength in the ambient air using the operating principle of mixing odorous ambient air with odor-free filtered air in discrete volume ratios. The Dilution to Threshold ("D/T") ratio is a measure of the number of dilutions needed to make the odorous ambient air non-detectable. A specification sheet for the Nasal Ranger olfactometer is presented in **Attachment C**.

Real-time air monitoring for VOCs (benzene-specific) will be performed using an UltraRAE 3000 (manufactured by RAE Systems, Inc.). The UltraRAE 3000 has a sensor range for monitoring benzene from 0 to 200 parts per million ("ppm") with a resolution of 0.05 ppm. This unit also provides a similar range and resolution for monitoring VOCs in general. A specification sheet for the UltraRAE 3000 monitoring instrument is presented in **Attachment C**.

MDNR has used AreaRAE and MultiRAE monitoring instruments (manufactured by RAE Systems, Inc.) during air quality monitoring at the Site in February and March 2013 and through the present time. These units monitor for VOCs in ambient air at the ppm level and also monitor other parameters such as oxygen, carbon monoxide, sulfur dioxide, gamma radiation, and combustible gases (as lower explosive limit ["LEL"] of methane in percent). The AreaRAE PID sensor range for VOCs is 0 to 199 ppm with a resolution of 0.1 ppm. Real-time air monitoring may also be performed using AreaRAE or MultiRAE instruments as requested by MDNR. These devices may also be used for air monitoring for health and safety purposes during sampling activities on-site at the Bridgeton Sanitary Landfill.

Air monitoring for H2S will be conducted using a Jerome J605 Gold Film H2S Analyzer (manufactured by Arizona Instruments LLC). The Jerome J605 instrument has a detection range of 3 ppb to 10 ppm with a resolution of 0.02 ppb. The Jerome J605 was purchased specifically for conducting low-level H2S monitoring at and around the Site. A Specifications Sheet for the Jerome J605 instrument is presented in **Attachment C**.

5.2. EQUIPMENT CALIBRATION

Air monitoring instruments will be calibrated prior to use each day of Daily Monitoring Event(s). Instrument calibrations will be recorded on a standard calibration log (see **Attachment B**). The UltraRAE 3000 instrument will be calibrated using a manufacturer-supplied zero and/or span gas in accordance with the manufacturer's instructions for calibration. The Nasal Ranger does not require any calibration and the Jerome J605 H2S analyzer only requires calibration periodically (approximately annually at the manufacturer's service center). If other monitoring instruments are utilized during the course of the project, then appropriate calibration routines will be adopted based on the respective manufacturer's recommended practices.

Following the completion of air monitoring activities, certain air monitoring instruments may be calibration checked using a process similar to a pre-monitoring calibration. However, a calibration check is different than a calibration in that during a check the instrument is only connected to a zero and/or span gas of known concentration and the resulting concentration is recorded on the calibration log. The calibration check is useful for tracking the performance of the instrument from pre-monitoring calibration through the completion of a screening survey.

5.3. AIR MONITORING LOCATIONS

Air monitoring will be conducted using a route map that will be developed with input from MDNR and based on the results of one or more initial Daily Monitoring Events. The routes that will be followed during the course of a typical air monitoring event will consist of public highways, streets, access roads, and other thoroughfares that connect monitoring station locations in a linear fashion. Project Personnel will determine the most efficient and effective monitoring routes with input from MDNR and based on the results of one or more initial monitoring events. A routine air monitoring route for collection of odor observations and other measurements is presented in **Attachment D**.

Project Personnel will coordinate with MDNR to access the Agency's meteorological station for determining various meteorological conditions such as temperature, wind direction, wind speed, barometric pressure, etc. To the extent that the meteorological station data is reasonably-accessible, Project Personnel will record the daily meteorological conditions prior to the initiation

of a Daily Monitoring Event (or other air sampling event, as discussed below) and utilize this information to coordinate specific air monitoring routes and/or locations.

5.4. MONITORING FREQUENCY

Air monitoring activities will be conducted based on a schedule to be developed in consultation with MDNR. Daily Monitoring Events will probably occur on a regular or modified schedule during periods of construction activity at the Site. Daily Monitoring Events may also be limited to alternate days or several scheduled days during a typical week as determined by MDNR. It is anticipated that Daily Monitoring Events will be more frequent during the first several weeks of the proposed air monitoring program. There are approximately 62 planned Daily Monitoring Events that will be conducted as part of the proposed air monitoring program.

Daily Monitoring Events will not always occur on the days that Weekly Monitoring Events and Comprehensive Monitoring Events are being conducted. However, dependent on construction activities and odor concerns, Daily Monitoring Events may occur on those same days.

5.5. ACTION LEVEL MONITORING

Air monitoring instrument readings will be recorded by Project Personnel in real-time. Instrument readings will be recorded onto a daily field log and compared to health-based screening levels, where one exists, during the collection of air quality measurements.

The United States Environmental Protection Agency ("U.S. EPA") has established Regional Screening Levels ("RSL") for contaminants in ambient and industrial air. The RSLs are risk-based concentrations derived from standardized equations combining exposure information assumptions with U.S. EPA toxicity data. RSLs are used for evaluating chronic or long-term exposures to toxic substances in industrial or residential settings. The Agency for Toxic Substances and Disease Registry ("ATSDR") has also published Minimal Risk Levels ("MRLs") and Environmental Media Exposure Guides ("EMEGs") for evaluating acute, short-term, and long-term exposures to toxic substances. Permissible Exposure Limits ("PELs"), which are developed by the Occupational Safety and Health Administration ("OSHA") and the National Institute for Occupational Safety and Health ("NIOSH"), are also established for occupational exposures to a variety of toxic substances found in occupational settings.

High levels of Chemicals of Concern ("COCs") are not anticipated to be present at the off-site locations where routine air monitoring is planned to occur. However, if any ambient COC levels measured at any monitoring location(s) exceed their respective PEL, then an immediate notification protocol will be activated. When air monitoring indicates a concentration greater than the PEL, Project Personnel will immediately alert the MDNR, local fire protection districts,

the MDNR's 24 Hour Spill-line, the St. Louis County Department of Health, Metropolitan St. Louis Sewer District (MSD), and the Missouri Department of Health and Senior Service, Bureau of Environmental Epidemiology.

6. AIR SAMPLING PROCEDURES

For Weekly and Immediate Sampling Events, Project Personnel will deploy sampling stations at approximately four (4) off-site locations in the community surrounding the Site. The parameters and laboratory methods for the Weekly and Immediate Sampling Events is presented in **Table 1**. Samples collected during these events will be analyzed for aldehydes, VOCs, and reduced sulfur compounds. As requested by MDNR, Project Personnel could mobilize on-site for collection of air samples using the same sampling equipment. A limited set of additional sampling equipment could also be requested from the analytical laboratory with advance notice, if such equipment is not being maintained by the local subcontractor. The contract allows for the number of sampling events to be expanded as needed due to construction or other activity at the Site.

The Comprehensive Sampling Event will include air sampling locations off-site and within areas of the Bridgeton Sanitary Landfill. For Comprehensive Sampling Events, Project Personnel will deploy sampling stations at approximately six (6) off-site locations in the community surrounding the Site, as well as two (2) locations on-site to sample ambient air. Three (3) additional samples are planned to be collected from the landfill gas source under the FML. The parameters and associated laboratory analytical testing methods that will be included in the sampling program for the Comprehensive Sampling Event(s) is presented in **Table 1**.

During the course of a typical air monitoring event, Project Personnel will document their activities on various project field forms that will be utilized throughout the course of the project. Project Personnel will document daily work activities, the results of sampling equipment calibration(s), observations during air sampling events, air monitoring and air sampling locations and readings from direct-reading instruments, and any other information, as necessary. Field forms that will be used during the course of this project are presented in **Attachment B**.

6.1. SAMPLING METHODS

Air sampling methods to be conducted during the Weekly, Immediate, and Comprehensive Sampling Events are generally discussed below. Additional details regarding the method-specific procedures for sampling and laboratory analysis are presented in the project QAPP document. The parameters and associated laboratory analytical testing methods that will be included in the sampling program is presented in **Table 1**.

Air samples to be analyzed for VOCs, reduced sulfur compounds and fixed gases will be collected at each location using a Summa® Canister. Each Summa® Canister used for ambient air sampling will be fitted with a flow controller set to sample air over a period of four (4) hours. Summa® Canister flow restrictors are calibrated by the analytical laboratory. Detailed sample collection procedures using Summa® Canister sampling equipment are discussed in the project

QAPP. Operation of the equipment is simple - the canister is deployed at the sampling location, where the canister flow control valve is opened to initiate air sampling. At around the close of the 4-hour sampling period, the control valve will be closed to conclude the air sampling.

Air samples to be analyzed for aldehydes, amines, ammonia, carboxylic acids, hydrogen chloride, hydrogen cyanide, mercury (elemental), and sulfur dioxide will be collected using individual sorbent tube sampling trains, each consisting of an air sampling pump and sorbent tube. Sorbent tube sampling trains used for sampling ambient air will be allowed to sample over a period of approximately four (4) hours. Each sampling pump and sorbent tube train will be set to a method-specific flow rate in the field at the time each sample is started. Air sampling pumps will consist of SKC AirCheck XR5000 units. Sorbent tubes to be used for each method are indicated in **Table 1**. All sorbent tube sampling equipment will be obtained from SKC, Inc. ("SKC") of Eighty Four, Pennsylvania. A flow calibration instrument will be used to adjust the flow rate for each sampling train, as discussed below. Detailed sample collection procedures using sorbent tube sampling equipment are discussed in the project QAPP. Specifications for sorbent sampling trains and calibration equipment are presented in **Attachment E**.

Air samples to be analyzed for dioxins/furans and PAHs will be collected using high-volume polyurethane foam ("PUF") cartridge samplers. Three (3) GMW Model GPS1 PUF samplers will be obtained from Clean Air Instrument Rental of Palentine, Illinois. Project Personnel will deploy these sampling units to designated sampling locations. Ambient air PUF samples are planned to be collected at three (3) off-site locations and one (1) on-site location. In addition, three (3) PUF samples are also planned to be collected from the landfill source gas. These samples will be collected by connecting the PUF sampler inlet to a sampling manifold that has been fixed into the landfill FML. Detailed sample collection procedures using the PUF sampling equipment are discussed in the project QAPP. Specifications for the PUF sampling equipment are presented in **Attachment F**.

Air samples will be collected for the quantification of perceived odors. Environmental odor samples will be collected in Tedlar® air sampling bags. For each air sample, a Tedlar® sampling bag will be placed into a vacuum sampling box and fitted with dedicated tubing to an internal air pump and valve fittings that connect to additional exterior valves. Tedlar® sampling bags and vacuum sampling equipment will be obtained from St. Croix Sensory, Inc. ("St. Croix") of Stillwater, Minnesota. Specifications for the Tedlar® sampling equipment and calibration are presented in **Attachment G**.

6.2. EQUIPMENT CALIBRATION

Sampling equipment calibration will be performed in the field. As indicated above, Summa® Canister flow restrictors are calibrated by the analytical laboratory; therefore, no calibration is

necessary for these sampling equipment. Flow restrictors will be calibrated and shipped individually with Summa® Canisters supplied by the analytical laboratory for this project (see **Section 7**).

Sorbent tube sampling equipment will be calibrated in the field prior to sampling. Initially, Project Personnel will ensure that each sampling pump battery is fully charged and operational. Each pump will then be paired with a method-specific sorbent tube and pre-set with a specific flow rate setting for the respective tube method (e.g., acetaldehyde). Pumps that are adjusted for each tube method will be affixed with a label indicating that flow adjustments have been pre-set. At the time of deployment at each sampling location, each pump will be fitted with a new sorbent tube and the flow rate calibrated using a DC-Lite Flowmeter. Flow calibration, flow readings, and start times for each sorbent tube sampling train will be recorded onto a pump calibration form in the field (see **Attachment B**). The flow rate will also be check using the DC-Lite Flowmeter prior to the completion of sampling for each sorbent tube sampling train.

6.3. AIR SAMPLING LOCATIONS

Project Personnel will deploy sampling equipment for air sampling at locations to be determined in the field based on input from the MDNR, information obtained from the MDNR meteorological stations, and/or based on other information. Preferred air sampling stations at off-site locations proximal to the Site are shown on a map presented as **Attachment H**. Additional off-site locations situated further away from the Bridgeton Sanitary Landfill may be considered.

During air sampling events such as Weekly and Immediate Sampling Events, a lockable metal enclosure will used to establish each air sampling station at off-site locations in the community. These metal enclosures will allow free air flow through each structure and will also protect and secure the air sampling equipment. Each air sampling station will contain one Summa® Canister and one sorbent tube sampling train, consisting of an air sampling pump and aldehydes sorbent tube. The sampling station enclosure will be secured to a structure in the public right-of-way (e.g., street light post) at each location.

During each Comprehensive Sampling Event, Project Personnel will deploy sampling equipment at each of the designated off-site air sampling stations (total of six locations). Off-site sampling during each Comprehensive Sampling Event is anticipated to take two days. On-site sampling will be conducted over a period of one or two days. Each sampling station will be monitored continuously by Project Personnel and security enclosures will not be used for the Comprehensive Sampling Event. Comprehensive Sampling Events will include the deployment of sampling stations with a Summa® Canister and multiple sorbent tube sampling trains, as well as the deployment of a PUF sampler at some locations. Project Personnel will place one Summa® Canister and several sorbent tube sampling trains (e.g., eight [8] units) into a weather-

resistant storage container or other shelter. At some locations, Project Personnel will also set up a PUF sampler, which is a metal enclosure approximately four feet in height. The PUF sampler equipment requires electrical power; therefore, Project Personnel will typically deploy a generator to each PUF sampling location.

Project Personnel will coordinate with MDNR to access the Agency's meteorological station. Project Personnel will record the daily meteorological conditions prior to the initiation of a Weekly, Immediate, or Comprehensive Monitoring Event and utilize this information to select specific air sampling locations.

6.4. SAMPLING FREQUENCY

Air sampling activities will be conducted based on a schedule to be developed in consultation with MDNR. Weekly and Immediate Monitoring Events are likely to occur on a regular schedule during periods of increased construction activity at the Site. It is anticipated that Weekly and Immediate Monitoring Events will be more frequent during the first several weeks of the proposed air monitoring program and during periods when specific construction activities and corrective actions are ongoing at the Site. There are approximately ten (10) planned Weekly Sampling Events and there is approximately one (1) planned Immediate Sampling Event that will be conducted as part of the proposed air monitoring program.

There are approximately two (2) planned Comprehensive Sampling Events that will be conducted as part of the proposed air monitoring program. The first Comprehensive Sampling Event will be conducted in mid-April 2013. It is anticipated that a second Comprehensive Sampling Event will occur in June 2013. The second Comprehensive Sampling Event may consist of a smaller set of air quality sampling parameters based on the results of the first round of Comprehensive Sampling and other factors in consultation with MDNR. The second Comprehensive Sampling Event is planned for the period when three reinforced concrete pipes ("RCPs") nearest the neck area between the South and North Quarries are abandoned which is likely sooner than June 2013.

6.5. ACTION LEVEL MONITORING

Air sampling results will be compared to various health-risk based screening levels, where one exists, once the results have been received from the analytical laboratories (see **Section 7**). Air sampling results will be compared to chronic and acute, health-risk based screening levels such as the RSLs and MRLs, as well as occupational exposure limits (i.e., PELs). The air sampling results will continue to be reviewed and a summary provided by the Department of Health and Senior Services, Bureau of Environmental Epidemiology.

High levels of COCs are not anticipated to be present at locations where air sampling is planned to occur. However, if ambient COCs are detected in air samples at levels that exceed their respective action levels (to be determined by MDNR) then an immediate notification protocol will be activated. When air sampling indicates a concentration greater than the PEL, Project Personnel will immediately alert the MDNR, local fire protection districts, the MDNR's 24 Hour Spill-line, the St. Louis County Department of Health, Metropolitan St. Louis Sewer District (MSD), and the Missouri Department of Health and Senior Service, Bureau of Environmental Epidemiology.

It should be noted that the normal laboratory turn-around time for most air sampling results will be 14 days or longer. Therefore, the use of air sampling analytical methods for the detection and assessment of air quality hazards is not effective for responding to real-time conditions at the landfill. However, because air monitoring is being conducted on a continuous basis at and around the Site by MDNR, it is anticipated that air monitoring systems and air monitoring activities conducted by Project Personnel will be effective for detecting COCs emissions from the Site that could exceed their respective MDNR action levels.

7. LABORATORY SERVICES

Several laboratories will be used for analytical testing of air samples collected during the Weekly, Immediate, and Comprehensive Sampling Events. Samples collected for the various testing parameters will be labeled, handled and shipped with Chain of Custody documentation in accordance with the procedures identified in the project QAPP document.

7.1. CHEMICAL ANALYSIS

Most of the chemical analytical testing is planned to be conducted by Atmospheric Analysis and Consulting, Inc. ("AAC") of Ventura, California. AAC will subcontract two other laboratories for analyses of sorbent tube air samples for mercury and PUF cartridge samples for dioxins/furans and PAHs. Analytical reports and data for all air sampling activities will be furnished to the Project Manager by AAC. Level IV reporting will be provided for all laboratory analytical testing. AAC will also provide the analytical data in electronic spreadsheet format. Laboratory precision objectives are discussed in the project QAPP document.

7.2. ODOR EVALUATION

Odor evaluation will be conducted by St. Croix. Air samples will be evaluated at St. Croix by trained human assessors (the assessor panel) observing presentations of the odorous air samples. Air samples are characterized using five basic parameters of human response, including: odor thresholds, odor intensity, odor persistency, hedonic tone, and odor characterization. A white paper with descriptions of the odor parameters evaluated by St. Croix is presented in **Appendix I**. Odor evaluation will be conducted in accordance with American Society for Testing and Materials ("ASTM") Method E679-04 (Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits).

7.3. DATA MANAGEMENT AND DELIVERY

The data to be collected will be used by MDNR to characterize the chemical properties of the air samples collected during the proposed field sampling events. The data may also be used to characterize potential exposures of members of the public to constituents potentially related to emissions from the Site by reporting on chemical constituents specifically found in the environment at the time and location of sample collection. The data may also be used by MDNR to make informed decisions related to appropriate protective actions necessary to ensure health and safety of members of the community.

The overall data quality objective for this project is to develop and implement procedures for Project Personnel to conduct field and laboratory activities that will provide results that meet the

project objectives and are defensible. A detailed description of data quality objectives and QA/QC procedures is presented in the project QAPP document. The project QAPP also describes documentation procedures and data delivery procedures that will be implemented to provide the MDNR with routine deliverables.

Project Personnel will use pre-printed field worksheets to accurately document all field activities: on-site conditions; field measurements; sample collection information; field instrument and calibration information; and other pertinent site-related information during monitoring and sampling activities. All information will be recorded in permanent black ink. Standard field forms that will be used for this project are presented in **Attachment B**.

The Project Manager will provide the MDNR with electronic data deliverables from the laboratory in a format that is acceptable to MDNR. Summary reports that document the results of air monitoring activities will also be prepared by Project Personnel and delivered to the MDNR by the Project Manager. The schedule for delivery of summary reports and electronic data deliverables will be coordinated with MDNR.

The MDNR will be sharing the reports and data with the Missouri Department of Health and Senior Services, Bureau of Environmental Epidemiology. Reports and data will be made available to the public via the Department's Internet Website.

Table 1 - Air Sampling Methods and Schedule

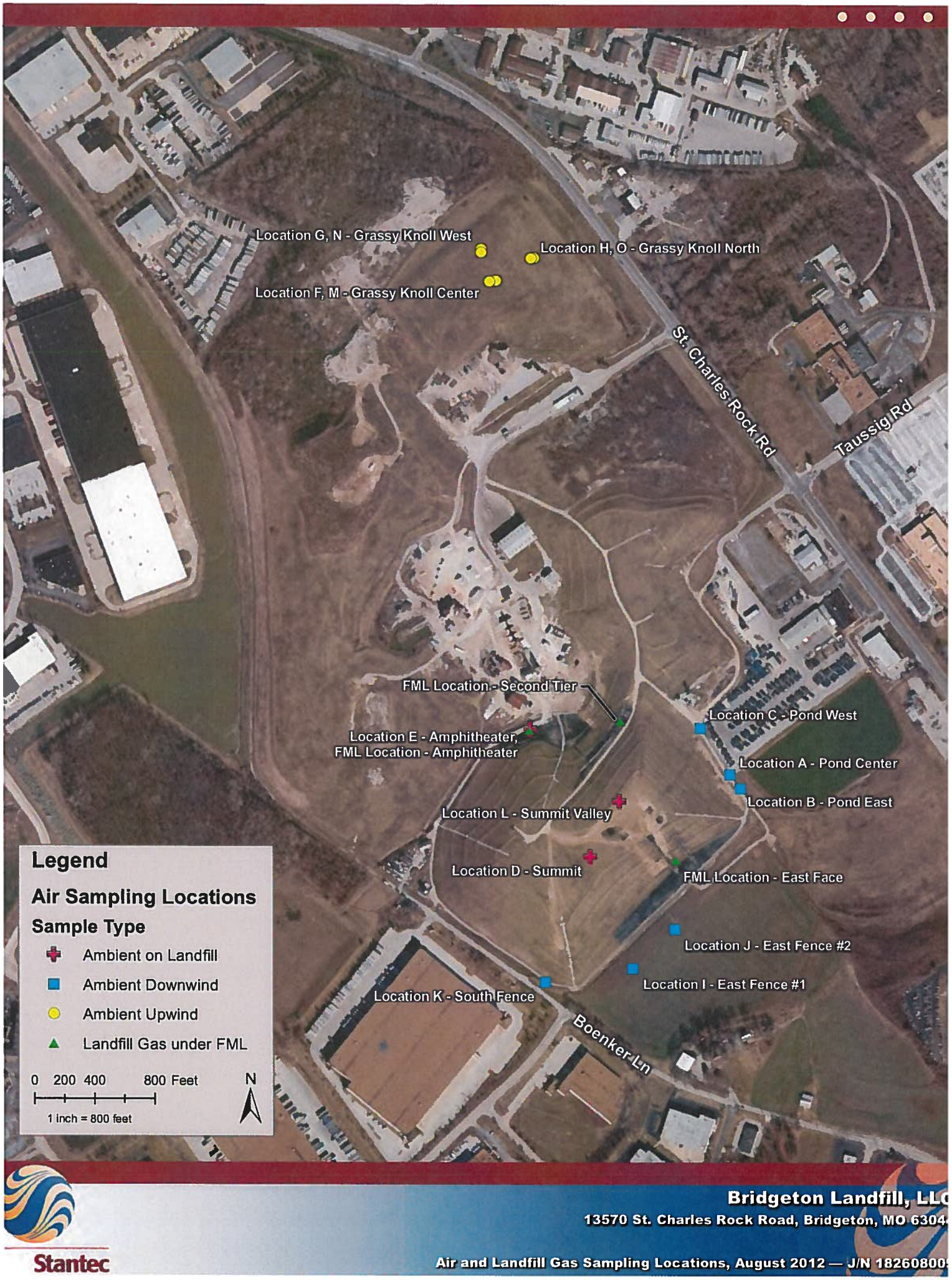
Sample type	Sampling Method / Equipment	Analytical Method	Comprehensive Sampling Event	Weekly / Immediate Sampling Event	Sampling Time[7]
Aldehydes	Battery-operated pump / sorbent tube (226-120)	EPA TO-11A	11 Locations[2]	4 Locations[3]	4 Hours
Amines	Battery-operated pump / sorbent tube (226-10)	NIOSH 2010M	11 Locations	NS	4 Hours
Ammonia	Battery-operated pump / sorbent tube (226-29)	OSHA ID-188	11 Locations	NS	4 Hours
Carboxylic acids	Battery-operated pump / sorbent tube (226-55)	Tube GC-MS[6]	11 Locations	NS	4 Hours
Hydrogen Chloride	Battery-operated pump / sorbent tube (226-10-03)	NIOSH 7903	11 Locations	NS	4 Hours
Hydrogen Cyanide	Battery-operated pump / sorbent tube (226-28)	NIOSH 6010	11 Locations	NS	4 Hours
Mercury (elemental)	Battery-operated pump / sorbent tube (226-17-1A)	NIOSH 6009	11 Locations	NS	4 Hours
Sulfur dioxide	Battery-operated pump / sorbent tube (226-80)	OSHA ID-200	11 Locations	NS	4 Hours
Dioxins/furans	One high-volume polyurethane foam (PUF) cartridge sampler for analysis of dioxins/furans and PAHs	EPA TO-9A	7 Locations[4]	NS	24 hours
PAHs		EPA TO-13A			
VOCs	One six-liter SUMMA® canister with 4-hour flow restrictor for analysis of VOCs, reduced sulfur compounds, and fixed gases	EPA TO-15	11 Locations	4 Locations	4 Hours
Reduced Sulfur Compounds		ASTM D5504		4 Locations	
Fixed gases		EPA 3C		NS	
Odor Evaluation	Vacuum chamber box / Tedlar bag	ASTM 679	8 locations[5]	NS	<30 minutes

Notes:

1) The schedule above is preliminary and subject to change. The analytical methods for sampling events may be adjusted as requested by MDNR.
2) The eleven (11) locations includes 3 upwind, 3 downwind, 2 on-site (ambient air), and 3 under the FML.
3) The four (4) locations includes 2 upwind and 2 downwind for both Weekly and Immediate Sampling Events.
4) The seven (7) locations includes 1 upwind, 2 downwind, 1 on-site (ambient air) and 3 under the FML.
5) The eight (8) locations includes 6 upwind/downwind and 2 on-site (ambient air).
6) The method will be performed by Atmospheric Analysis and Consulting, Inc. using GC-MS.
6) Sampling locations and scheduling may vary due to access restriction, landfill activities and events.
7) Samples taken under FML will be of shorter duration, to be determined.

ATTACHMENT A

Maps Depicting the Bridgeton Sanitary Landfill and Previous Sampling Locations



Stantec

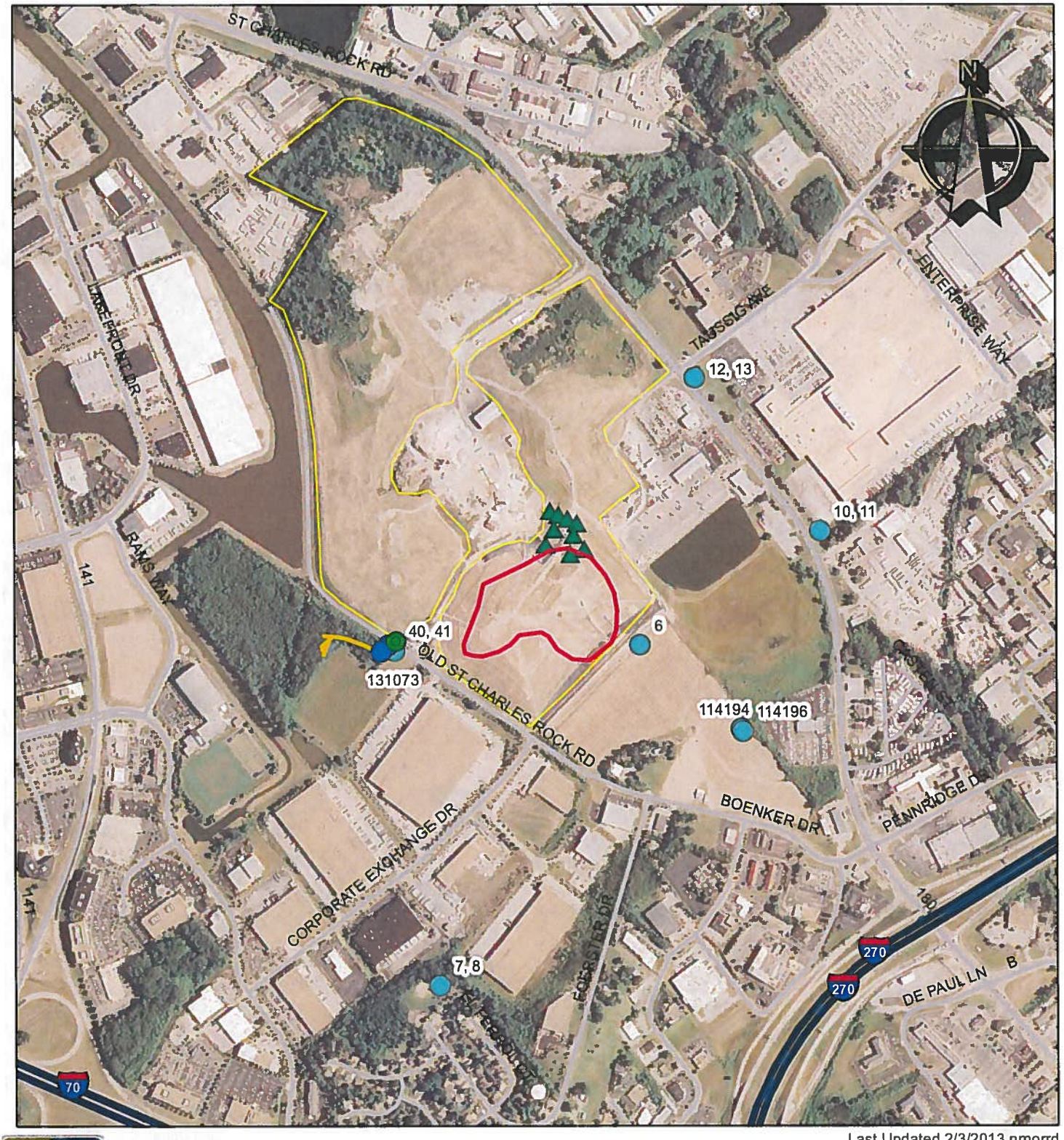
Bridgeton Landfill, LLC

13570 St. Charles Rock Road, Bridgeton, MO 6304

Air and Landfill Gas Sampling Locations, August 2012 — J/N 18260800

tachment 5

Bridgeton Sanitary Landfill
February 2, 2013 Sampling Locations by Unit ID



Last Updated 2/3/2013 nmorrd

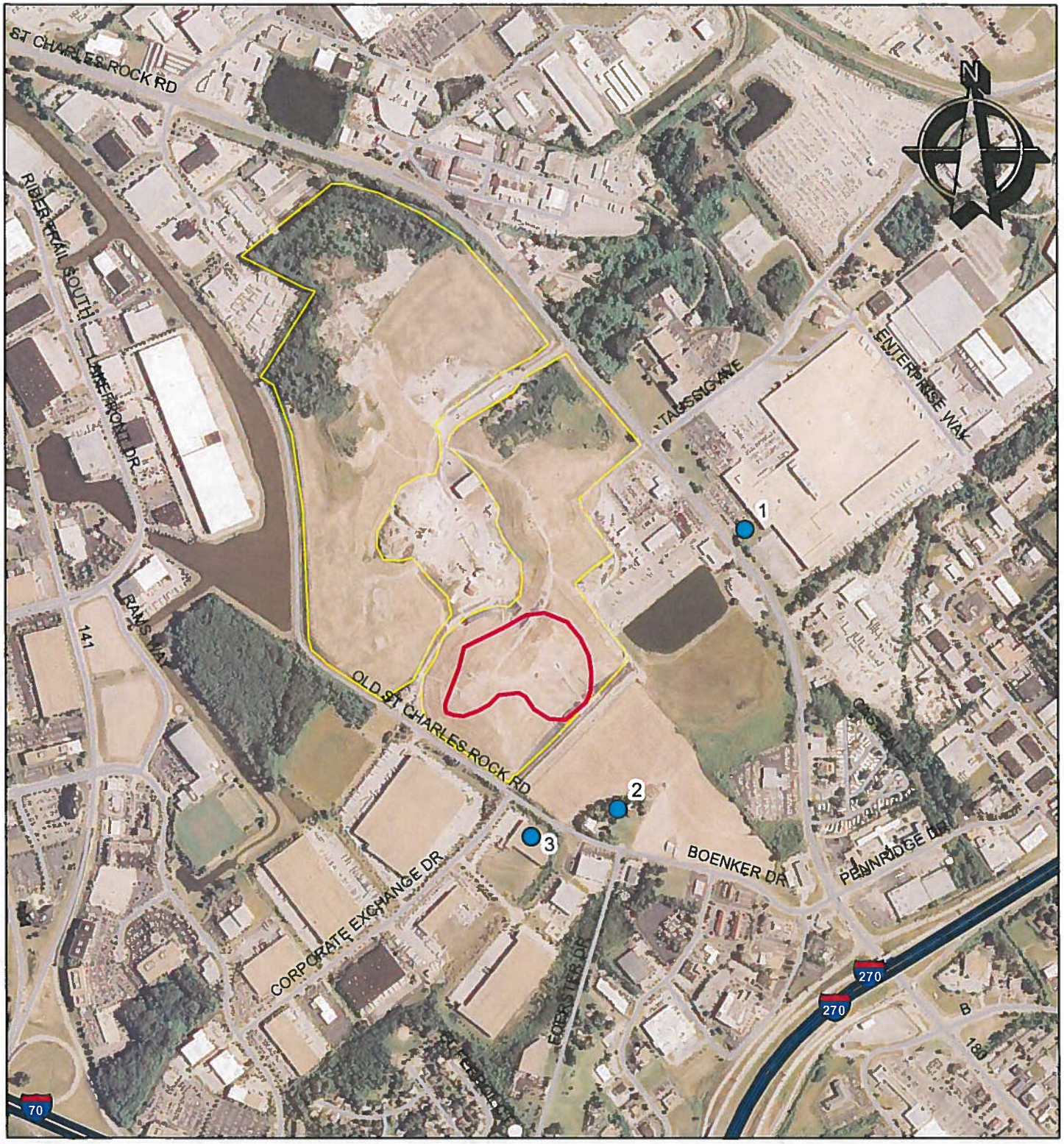
Missouri Department of Natural Resources
Division of Environmental Quality
Solid Waste Management Program

0 375 750 1,500 Feet

Legend

- Outfall 003
- Leachate Sample
- Air Sample
- Leachate Spill
- Waste Areas (approximate)
- Temperature Monitors (approximate)
- Approximate Smoldering Event Location

Bridgeton Sanitary Landfill
February 2013 VIPER Air Sampling Locations



Last Updated 2/19/2013 nrnorrd

Missouri Department of Natural Resources
Division of Environmental Quality
Solid Waste Management Program

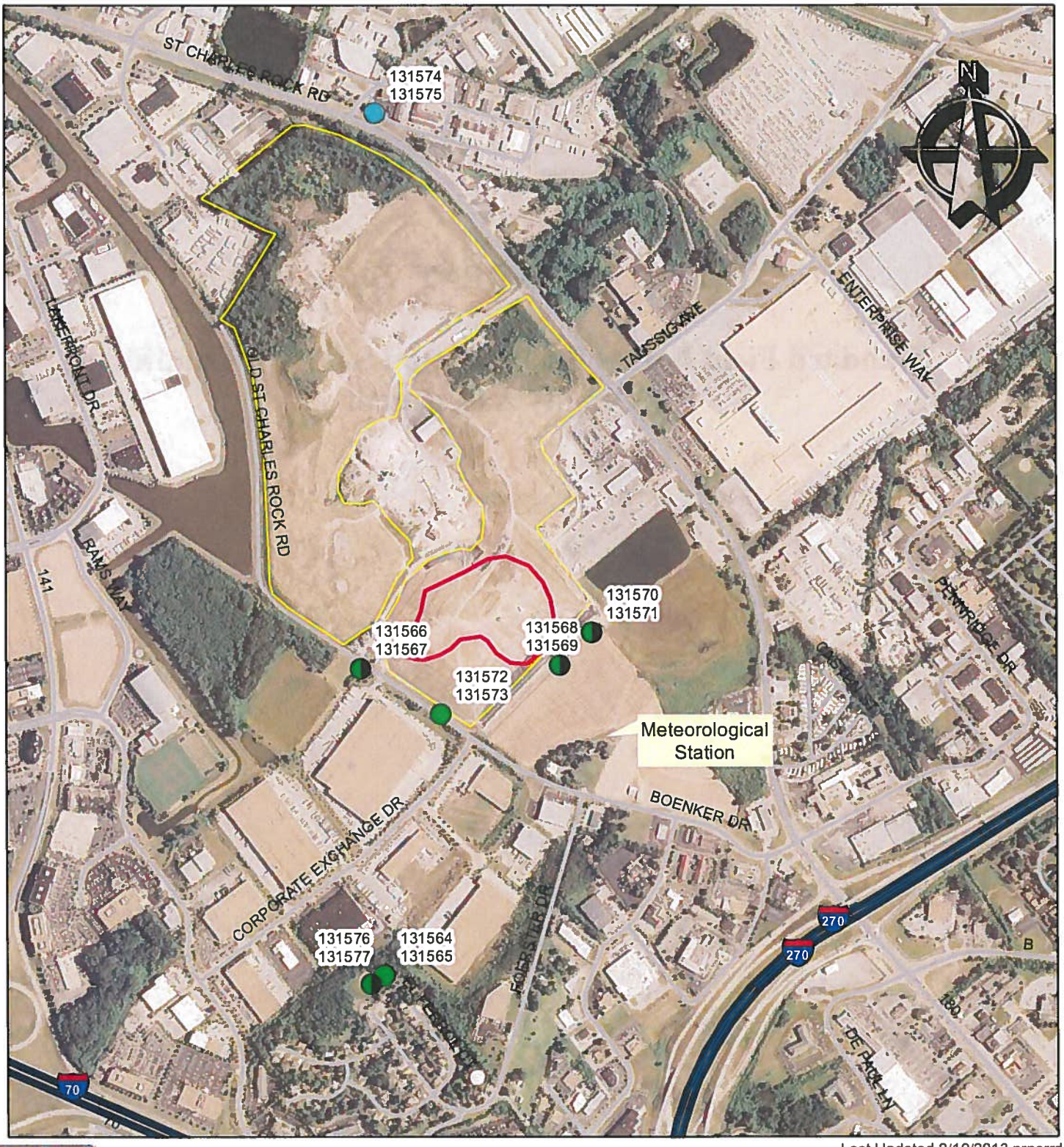
0 375 750 1,500 Feet

Although data sets used to create this map have been compiled by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials.

Legend

- Sample Location
- Waste Areas (approximate)
- Thermal Event Area (approximate)

Bridgeton Sanitary Landfill
February 4, 2013 Sampling Locations



Last Updated 2/19/2013 nrnorrd

Missouri Department of Natural Resources
Division of Environmental Quality
Solid Waste Management Program

0 375 750 1,500 Feet

Although data sets used to create this map have been compiled by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials.

Legend

Type, Duration

- Downwind, 4 Hour
- Downwind, Grab
- Upwind, Grab

- Waste Areas (approximate)
- Thermal Event Area (approximate)
- DNR sample ID
- VOC sample
- Aldehyde sample

ATTACHMENT B

Standard Field Forms for Bridgeton Sanitary Landfill Air Quality Assessment

DAILY FIELD ACTIVITIES LOG

Bridgeton Sanitary Landfill Air Quality Assessment

COMPLETED BY: ____________ **PERSONNEL:** ____________

DATE: ____________

PAGE: ______ **of** ______

FIELD NOTES

TIME (24-HR) *DESCRIPTION OF ACTIVITIES*

AMBIENT AIR MONITORING DATA COLLECTION SHEET

Bridgeton Sanitary Landfill Air Quality Assessment

COMPLETED BY: _____ **PERSONNEL:** _____

DATE: _____

PAGE: _____ **of** _____

WEATHER READINGS / OBSERVATIONS

Time (24 Hour)	Ambient Temperature (deg F)	Barometric Pressure (in Hg)	Wind Speed (mph)	Wind Direction	Notes

INSTRUMENTS (Use a separate Calibration & Post-Monitoring Check Log for instrument calibration)

Instrument ID	Measured Parameter	Units	Calibration Date / Time	Notes

AMBIENT AIR MONITORING

Time (24 Hour)	Monitoring Location	Instrument ID	Measured Parameter	INSTRUMENT READING	Comment (see Notes)

NOTES _____

AMBIENT AIR MONITORING DATA COLLECTION SHEET

Bridgeton Sanitary Landfill Air Quality Assessment

COMPLETED BY: _____ **PERSONNEL:** _____

DATE: _____

PAGE: _____ **of** _____

AMBIENT AIR MONITORING

Time (24 Hour)	Monitoring Location	Instrument ID	Measured Parameter	INSTRUMENT READING	Comment (see Notes)

NOTES _____

CALIBRATION & POST-MONITORING CHECK LOG

Bridgeton Sanitary Landfill Air Quality Assessment

COMPLETED BY: _____ **PERSONNEL:** _____ **WEATHER:** _____

DATE: _____

PAGE: _____ **of** _____

Instrument ID	Date	Pre-Monitoring Calibration				
		Time (24 Hour)	Zero Gas		Span Gas	
			Calibration Gas	Instrument Reading	Calibration Gas	Instrument Reading

Post-Monitoring Check				
Time (24 Hour)	Zero Gas		Span Gas	
	Calibration Gas	Instrument Reading	Calibration Gas	Instrument Reading

NOTES

AIR SAMPLING PUMP CALIBRATION LOG

Bridgeton Sanitary Landfill Air Quality Assessment

COMPLETED BY: _____ **PERSONNEL:** _____

DATE: _____ _____

PAGE: _____ **of** _____ _____

CALIBRATION INSTRUMENT : _____

INITIAL PUMP SETUP (PRE-SAMPLING FLOW CHECK)

Sample ID	Analyte	SKC Tube ID	Air Pump Serial No.	START		END	
				Flow Rate (L/min)	Time (24 Hour)	Flow Rate (L/min)	Time (24 Hour)
e.g. acetaldehyde	e.g. acetaldehyde	e.g. 226-120	e.g. 123456				

NOTES / LOCATION REFERENCES

TUBES:	ANALYTE	SKC TUBE ID	ANALYTE	SKC TUBE ID
	Aldehydes	226-120	Hydrogen Chloride	226-10-03
	Amines	226-10	Hydrogen Cyanide	226-28
	Ammonia	226-29	Mercury (elemental)	226-17-1A
	Carboxylic Acids	226-55	Sulfur Dioxide	226-80

CHAIN OF CUSTODY RECORD / ANALYTICAL REQUEST FORM

Bridgeton Sanitary Landfill Air Quality Assessment

Client Name:	Telephone No. / Fax No.:	Date:	Page of
SOIL / WATER AIR PROTECTION ENTERPRISE	(310) 434-0110 / (310) 434-0011		

Project Manager:	Address:	Project Name and Location:	Sampled By:	Sampler Signature:
PAUL ROSENFELD, PH.D.	1640 FIFTH STREET, SUITE 204, SANTA MONICA, CA 90401	BRIDGETON SANITARY LANDFILL AIR QUALITY ASSESSMENT		

LAB ID	SAMPLE ID NUMBER	Type	Date	Time	VOCS - EPA TO-15	Reduced Sulfur Compounds - ASTM D5504	Aldehydes - EPA TO-11A	Carboxlyic Acids - Tube GC-MS	HCL - NIOSH 7903	Ammonia - OSHA ID-188	SO2 - OSHA ID-200	HCN - NIOSH 6010	Amines - NIOSH 2010M	Fixed Gases - EPA 3C	PAHs / Dioxins EPA TO-13A / 9A	Mercury - NIOSH 6009	Odor Evaluation	Special Instructions / Conditions of Receipt

REQUESTED TESTS / ANALYSES

Requested Turnaround Time:	QC Requirements:
Standard turn-around for all analyses. If possible deliver report within 2 weeks.	Provide Level IV QC Package for all Analyses.

Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

ATTACHMENT C

Specification Sheets for Air Monitoring Instruments

THE NASAL RANGER® FIELD OLFACTOMETER

OPERATION MANUAL

Version 6.2

U.S. Patent No.: 6,595,037

St. Croix Sensory, Inc.

www.NasalRanger.com
info@NasalRanger.com
+651-439-0177 / 800-879-9231

NASAL RANGER® FIELD OLFACTOMETER

INTRODUCTION TO FIELD OLFACTOMETRY

The Nasal Ranger® Field Olfactometer is the "state-of-the-art" in field olfactometry for confidently measuring and quantifying odor strength in the ambient air. The Nasal Ranger® Field Olfactometer, a portable odor detecting and measuring device, determines ambient odor "Dilution-to-Threshold" (D/T) values objectively.

Field olfactometry can be used as a proactive monitoring or enforcement tool for confident odor measurement at property lines and in the neighboring community. Quantifying ambient odor is often needed for the following purposes:

1. Monitoring daily operations (i.e. management performance evaluations),
2. Comparison of operating practices (i.e. evaluating alternatives),
3. Documenting specific events or episodes (i.e. defensible, credible evidence),
4. Monitoring compliance (i.e. compliance assurance for permits),
5. Determination of compliance (i.e. permit renewal),
6. Determination of status (i.e. baseline data for expansion planning),
7. Investigation of odor control effectiveness (i.e. scientific testing),
8. Verification of odor dispersion modeling (i.e. model calibration),
9. Determination of specific odor sources (i.e. investigation of complaints),
10. Verification of complaints (i.e. notice of violation).

The Nasal Ranger® Field Olfactometer, as a nasal organoleptic instrument, provides field olfactometry with a scientific method for dependable ambient odor quantification.

In 1958 the U.S. Public Health Service sponsored the development of an instrument and procedure for **field olfactometry** (ambient odor strength measurement) through Project Grants A-58-541, A-59-541, and A-60-541. The Barnebey-Cheney Company originally manufactured a field olfactometer instrument based on these grants, known as a "scentometer".

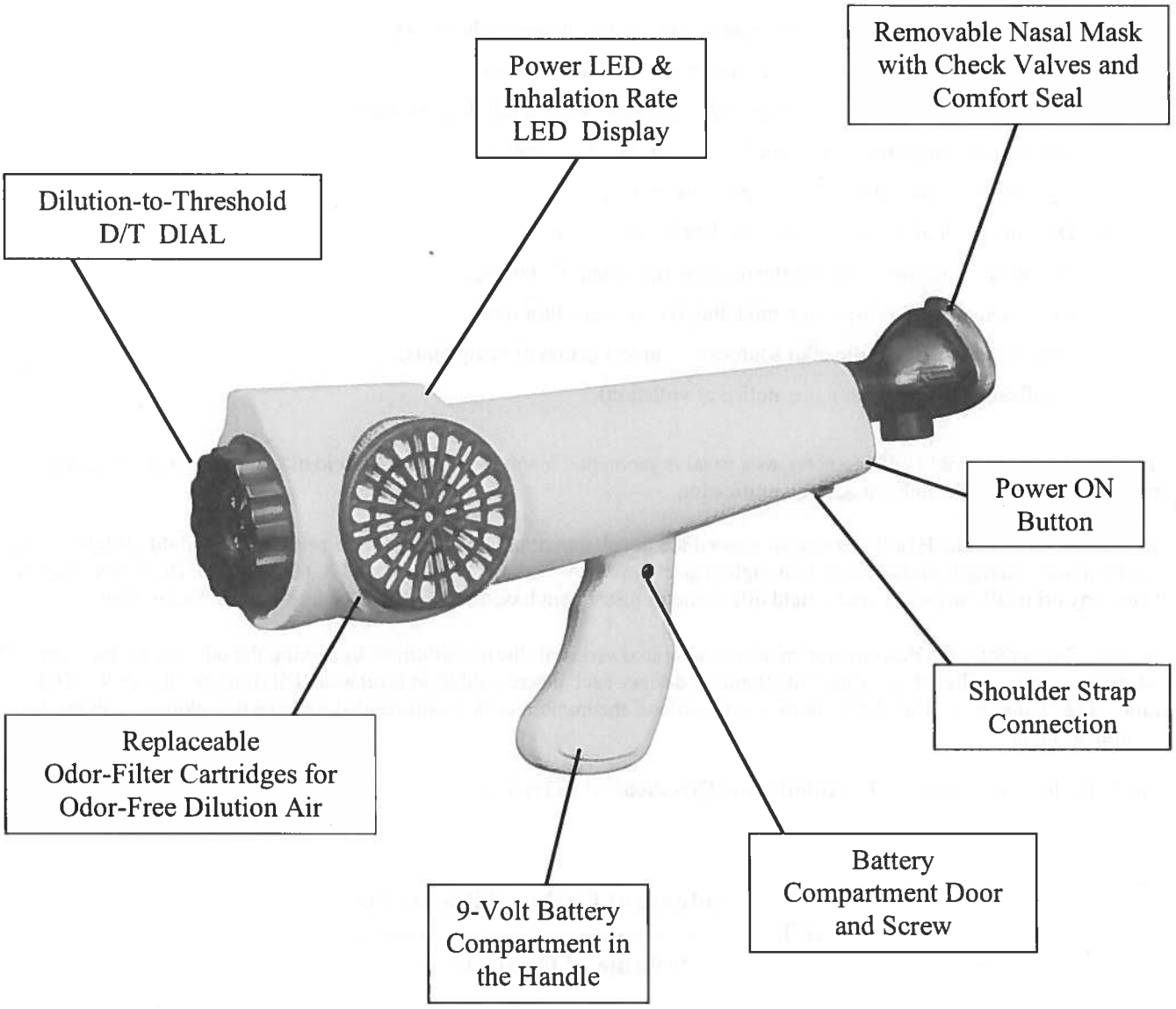
A Nasal Ranger® Field Olfactometer creates a calibrated series of discrete dilutions by mixing the odorous ambient air with odor-free (carbon) filtered air. Field olfactometry defines each discrete dilution level as a "Dilution-to-Threshold," **D/T**, ratio. The "Dilution-to-Threshold" ratio is a measure of the number of dilutions needed to make the odorous ambient air "non-detectable".

Field olfactometry calculates the **"Dilution-to-Threshold"** (D/T) ratio as:

$$D/T = \frac{\text{Volume of Carbon-Filtered Air}}{\text{Volume of Odorous Air}}$$

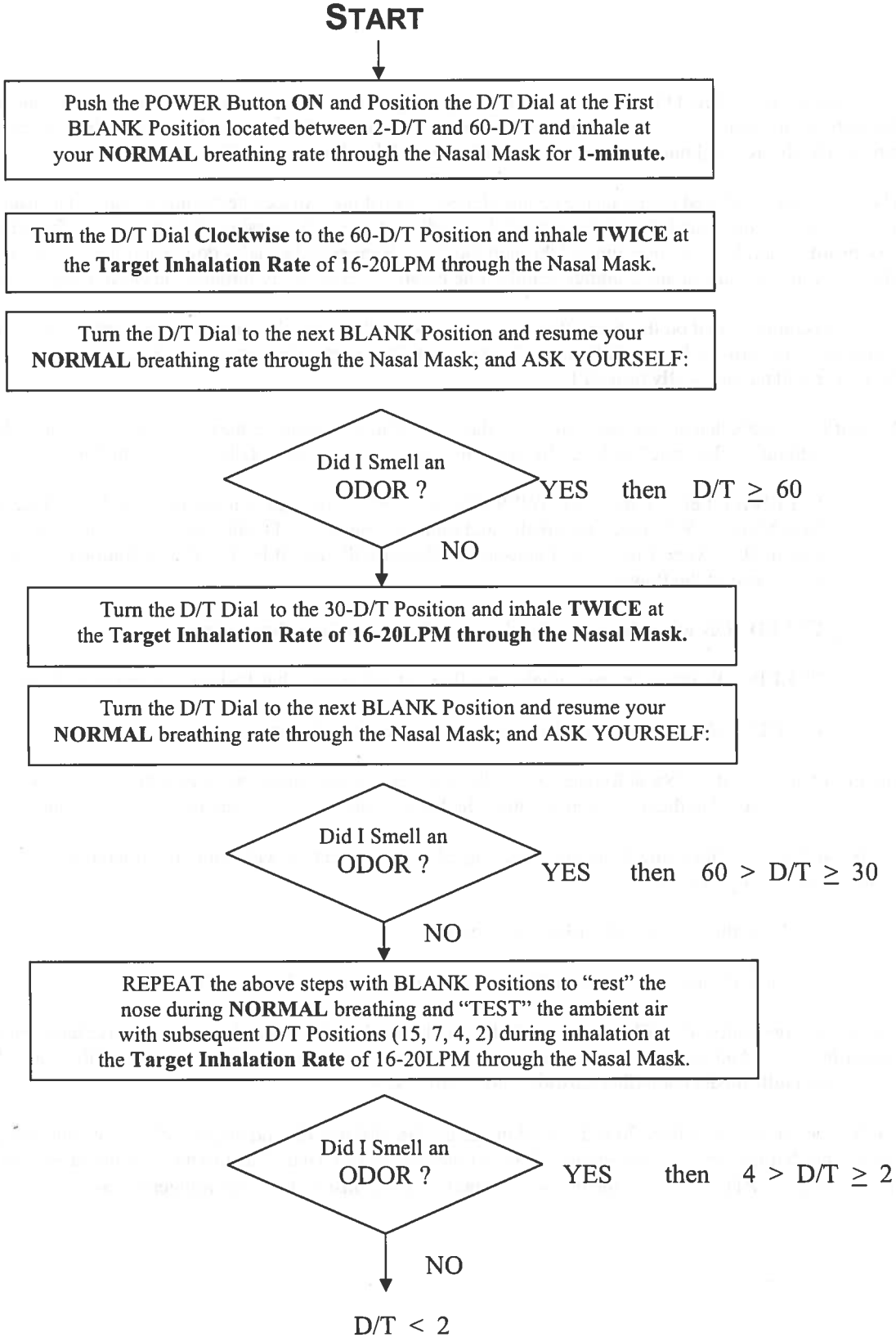
NASAL RANGER® FIELD OLFACTOMETER

COMPONENT DIAGRAM



NASAL RANGER® FIELD OLFACTOMETER

TEST PROCEDURE FLOW CHART



NASAL RANGER® FIELD OLFACTOMETER

OPERATING PRINCIPLE

The Nasal Ranger® Field Olfactometer, a nasal organoleptic instrument, directly measures and quantifies odor strength in the ambient air using the Operating Principle of mixing odorous ambient air with odor-free filtered air in discrete volume ratios. The discrete volume ratios are called "Dilution-to-Threshold" ratios (D/T ratios).

The user's nose is placed firmly inside the nasal mask against the replaceable "comfort seal". The user inhales through the nasal mask at a comfortable breathing rate while standing at rest. The nasal mask has an outlet for exhaled air to exhaust downward. Therefore, the user inhales through the Nasal Ranger and exhales downward through the outlet check valve. The user can stand at rest and continue comfortable breathing exclusively through the Nasal Ranger Field Olfactometer.

A Power Button located on the Nasal Ranger Housing, directly below the nasal mask, is pushed once by the user to turn the Power ON. To turn the Power OFF manually the Power Button must be pressed for 3-seconds. After 5-minutes of non-use the Power will automatically turn OFF.

A set of LED lights that are recessed on top of the Nasal Ranger housing indicate when the inhalation flow rate is within the "factory calibration flow rate" of 16-20 liters per minute. The four (4) LED lights have the following functions:

> **1st LED** (on Left): Indicates POWER ON. After 45-seconds of non-use this first LED blinks slowly in a "Power Save Mode". When the user inhales and initiates flow the LED will "wake" from the Power Save Mode and remain ON. After 5-minutes of non-use the Power will turn OFF. The Power Button must be pushed once by the user to restart the Power.
>
> **2nd LED**: ON when the user is inhaling at a flow rate of less than 16-lpm.
>
> **3rd LED**: ON when the user inhales at a flow rate of greater that 16-lpm and less than 20-lpm.
>
> **4th LED**: ON when the user inhales at a rate greater than 20-lpm.

Therefore, the user of the Nasal Ranger Field Olfactometer learns to inhale at a rate sufficient to ONLY light up the third LED and be assured that the inhalation is within the factory calibrated flow rate range of 16-20lpm.

The Nasal Ranger's Operating Principle of mixing odorous ambient air with odor-free filtered air in discrete volume ratios is achieved using two airflow paths:

1. Flow through the odor-filter cartridge and
2. Flow through one of the orifices in the D/T (Dilution-to-Threshold) Dial.

The first airflow path is the "filtered air" path through both odor-filter cartridges that are attached to each side of the Nasal Ranger housing. Ambient air, that may be odorous, enters through the outside of both odor-filter cartridges and travels through the multi-media odor-filter cartridges to remove odors.

The filtered odor-free air then flows forward inside the Nasal Ranger® and mixes with the second flow path, which is the odorous air that has entered through one of the orifices on the D/T Dial. The mixture of filtered air and odorous air then travels down the PTFE Barrel to the users nose that is in place inside the Nasal Ranger® mask.

NASAL RANGER® FIELD OLFACTOMETER

OPERATING PRINCIPLE (CONTINUED)

A precision electronic flow meter that is built in to the Nasal Ranger® Barrel measures the "total volume" of mixed airflow that is traveling down the PTFE Barrel on the way to the nasal mask. The LED lights recessed on top of the Nasal Ranger housing indicate to the user when the inhalation flow rate is within the "factory calibration flow rate" of 16-20 liters per minute.

The rotational position of the Nasal Ranger D/T Dial determines the orifice size and, therefore, the volume of odorous air that enters through the selected orifice. A large orifice allows more odorous air through the D/T Dial to mix with odor-free filtered air. A small orifice allows less odorous air through the D/T Dial to mix with odor-free filtered air. The volume ratio of the filtered odor-free air and odorous air is called the Dilution-to-Threshold (D/T) ratio. The principle of field olfactometry calculates the "Dilution to Threshold" (D/T) ratio as:

$$D/T = \frac{\text{Volume of Carbon-Filtered Air}}{\text{Volume of Odorous Air}}$$

The D/T Dial contains twelve (12) orifice positions. Six (6) positions are "BLANK" positions for the user to inhale only odor-free filtered air. Alternating on the D/T Dial with the six "BLANK" positions are six "D/T" positions with discrete "Dilution-to-Threshold" (D/T) orifices with traceable calibration.

The following table summarizes the "Dilution-to-Threshold" (D/T) ratios on the standard Nasal Ranger® D/T Dial.

Position Number	D/T
1	Blank
2	60
3	Blank
4	30
5	Blank
6	15
7	Blank
8	7
9	Blank
10	4
11	Blank
12	2

A raised arrow is on the rim of the D/T Dial adjacent to the Blank "Starting Position", Position No. 1.
A Braille raised DOT is on the rim of the D/T Dial adjacent to each of the D/T Positions.

Please contact St. Croix Sensory, Inc. at 1-800-879-9231 (+651-439-0177), or visit www.NasalRanger.com with inquiries regarding Nasal Ranger D/T Dials with other "Dilution-to-Threshold" (D/T) ratios.

RAE SYSTEMS

UltraRAE 3000

Portable Handheld Compound-Specific VOC Monitor

The UltraRAE 3000 is the most advanced Compound-Specific Monitor on the market. Its Photoionization Detector's (PID) extended range of 0.05 to 10,000 ppm in VOC mode and 50 ppb to 200 ppm in benzene-specific mode makes it an ideal instrument for applications, from entry pre-screening during refinery and plant maintenance to hazardous material response, marine spill response and refinery down-stream monitoring.

- **Dual detection mode for total benzene exposure assessment: 60-second snap-shot or 15-minute STEL measurement**
- **High sensitivity to benzene (as low as 50 ppb) provides a lower detection range for future benzene exposure limits**
- **Lower risk of false alarms through advanced speciation method**
- **Total VOC measurement mode with extended range of 0.05 to 10,000 ppm**

KEY FEATURES

- Proven PID technology
  - 3-second response in VOC mode or 60 seconds in compound-specific mode
  - Extended range up to 10,000 ppm (in VOC mode) with improved linearity
  - Built-in humidity sensor
  - Automatic temperature-controlled sampling time calculation
  - Highly specific readings, combining a 9.8eV UV lamp and RAE-Sep™ benzene tube
- New sampling probe design provides instant tube-breakthrough visibility
- Versatile VOC or Benzene-Specific modes
- Real-time wireless with built-in Bluetooth and optional RAELink3 portable modem
- Integrated RAE Systems Correction Factors list for more than 200 compounds

Easy to Use

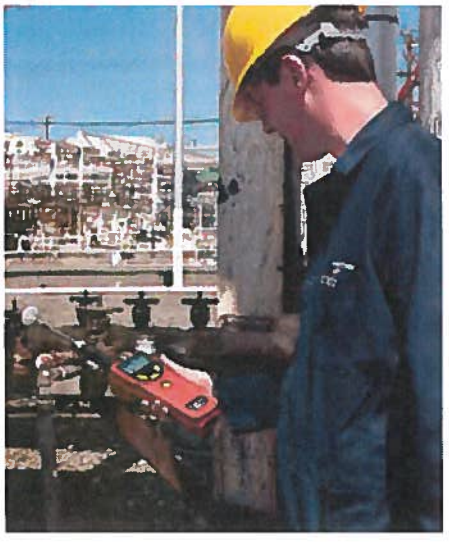
- Large graphic display
- Multi-language support
- Easy access to lamp, sensor and battery in seconds without tools

Low Cost of Ownership

- Inexpensive analysis using low-cost RAE-Sep tubes

Applications

- Confined space entry pre-screening during refinery and plant maintenance
- Hazardous material response
- Marine spill response
- Refinery down-stream monitoring
- Plant overhaul



Workers can easily and quickly obtain VOC readings anywhere in the facility with the RAE Systems UltraRAE 3000

Wireless | AutoRAE Compatible | ISO 9001 CERTIFIED | IECEx | ATEX

UltraRAE3000

Portable Handheld Compound-Specific VOC Monitor

SPECIFICATIONS

Monitor Specifications

Size	10" L x 3.0" W x 2.5" H (25.5 x 7.6 x 6.4 cm)
Weight	26 oz (738 g)
Sensors	Photoionization sensor with standard 9.8 eV or optional 10.6 eV or 11.7 eV lamps
Battery	• Rechargeable, external field-replaceable lithium-ion battery pack • Alkaline battery adapter
Operating Hours	16 hours of operation
Display Graphic	4 lines, 28 x 43mm
Keypad	1 operation and 2 programming keys, 1 flashlight on/off button
Direct Readout	• VOCs as ppm by volume • High and low values • STEL and TWA • Battery and shutdown voltage • Date, time, temperature
Alarms	• 95dB buzzer (at 12"/30 cm) and flashing red LED to indicate exceeded preset limits • High: 3 beeps and flashes per second • Low: 2 beeps and flashes per second • STEL and TWA: 1 beep and flash per second • Alarms latching with manual override or automatic reset • Additional diagnostic alarm and display message for low battery and pump stall
EMI/RFI	Highly resistant to EMI/RFI. Compliant with EMC directive (2004/108/EC), R & TTE directive (1999/5/EC)
IP Rating	IP-65, unit running
Datalogging	Standard 6 months at one-minute intervals
Calibration	2-point or 3-point calibration for zero and span. Calibration memory for 8 calibration gases, alarm limits, span values and calibration dates
Sampling Pump	• Internal, integrated flow rate at 400 cc/min • Sample from 100' (30m) horizontally and vertically
Low Flow Alarm	Auto shut-off pump at low-flow condition
Communication	• Download data and upload instrument setup from PC through charging cradle • Wireless data transmission through built-in Bluetooth™
Frequency for RAELink3 Optional Modem	902 to 928 MHz (license-free), 2.400 to 2.4835 GHz (license-free), 433 MHz, 869 MHz
Wireless Network	ProRAE Guardian Real-Time Wireless Safety System
Wireless Frequency	ISM license-free bands
Wireless Range (Typical)	UltraRAE 3000 to RAELink3 or RAELink3 Z1 modems – 33 feet (10 meters)
Hazardous Area Approval	• US and Canada: , Classified as Intrinsically Safe for use in Class I, Division 1 Groups A, B, C, D. • Europe: ATEX II 2G EEx ia IIC T4 • IECEx CSA 10.0005 Ex ia IIC/IIB GbT4
Operating Temperature	-4° to 122° F (-20° to 50° C)
Humidity	0% to 95% relative humidity (non-condensing)
Attachments	Durable bright red rubber boot
Warranty	3 years for 10.6 eV lamp, 1 year for 9.8. eV lamp, pump, battery, sensor and instrument

Specifications are subject to change

Sensor Specifications

Gas Monitor	Range	Resolution	Response Time (T90)
VOCs	0 to 99.99 ppm	0.05 ppm	< 3 sec
	100 to 999.9 ppm	0.1 ppm	< 3 sec
	1000 to 9999 ppm	1 ppm	< 3 sec
Benzene	0 to 200 ppm	0.05 ppm	< 60 sec
Butadiene	0 to 200 ppm	0.05 ppm	< 60 sec

ULTRARAE 3000 ORDERING OPTIONS

Monitor Only Includes

- UltraRAE 3000 Monitor, Model PGM-7360
- Wireless communication module built-in
- Datalogging with ProRAE Studio II Package for Windows® XP, Windows® Vista, or Windows® 7
- Travel Charger
- RAE UV lamp and RAE-Sep™ Tubes
- Flex-I-Probe™ and short probe
- External filter
- Red rubber boot
- Alkaline battery adapter
- Lamp-cleaning kit
- Tool kit
- Lithium-ion (Li-Ion) battery with universal AC/DC charger and international plug kit
- Operation CD-ROM
- Operation & Maintenance manual
- Soft leather carrying case

Monitor with Accessories Kit

- Hard transport case with pre-cut foam padding
- Charging/download cradle
- 5 porous metal filters and O-rings
- Organic vapor zeroing kit
- Gas outlet port adapter and tubing

Optional Calibration Kit

- Calibration gas, 34L, as specified
- Calibration regulator and flow controller

Optional Guaranteed Cost of Ownership Program

- 4-year repair and replacement guarantee
- Annual maintenance service

Ordering Information

Monitor with Accessories and Calibration Kit (PN 059-D311-200)

CORPORATE HEADQUARTERS

RAE Systems, Inc.
3775 North First Street
San Jose, CA 95134 USA
raesales@raesystems.com

WORLDWIDE SALES OFFICES

USA/Canada 1.877.723.2878
Europe +45.86.52.51.55
Middle East +00971.4.440.5949
China +86.10.5885.8788-3000
Asia Pacific +852.2669.0828

The Home of
JEROME®

APPLICATIONS

Agricultural Applications
Ambient Air Analysis
Applied Research
Control Room Corrosion Monitoring
Hydrogen Sulfide Source Detection
Landfills
Leak Detection
Quality Control
Regulatory Compliance and Permitting
Scrubber Efficiency Testing

CERTIFICATIONS

UL and CE
ISO 9001:2008

MADE IN THE USA

ARIZONA INSTRUMENT LLC
3375 N Delaware St | Chandler, AZ
www.azic.com

JEROME® J605
Gold Film Hydrogen Sulfide Analyzer

The newest instrument from AZI is the Jerome® J605 Hydrogen Sulfide Analyzer. The Jerome® J605 can read as low as 3ppb with an incredible resolution to 20ppt.

The J605 is housed in a light and ergonomically designed case, setting a new precedence for low-level, portable monitors. The industry-proven, gold film sensor has been upgraded and improved from previous models, resulting in longer life expectancies.

FEATURES

No PC Software Required
20,000 Data Points | On-Board Data Logging
Stores Date, Time and Locations
USB Interface for Data Transfer
Battery Powered Sensor Regeneration | 24 Hour Battery Life
Detection H_2S Levels as Low as 3 ppb
SCADA Interface Capabilities via 4-20ma
Functional Test Module (FTM) Verifies Instrument Functions Correctly Between Recommended Annual Factory Calibrations

SPECIFICATIONS

Resolution	20 ppt (0.02 ppb) (range dependent)	
Detection Range	3 ppb (0.003 ppm) - 10 ppm in three graduated ranges	
Data Storage Capacity	20,000 samples	
Operating Environment	0-40°C non-condensing, non-explosive	
Accuracy	5 ppb	±1 ppb (range 0)
	50 ppb	±3 ppb (range 0)
	0.5 ppm	±0.03 ppm (range 1)
	5.0 ppm	±0.3 ppm (range 2)
Typical Response Time	Dependent on Range and Mode	
	MANUAL SURVEY MODE: 12-27 seconds	
	AUTO SAMPLE MODE: 12-52 seconds	
	MANUAL SAMPLE MODE: 12-27 seconds	
	AUTO SAMPLE MODE: 12-52 seconds	

The Home of
JEROME®

Rentals Available
24 Hour Customer Support

Sales Representatives
800.528.7411 | 602.470.1414
sales@azic.com

Extended Warranties and Parts
800.528.7411 | 602.470.1414
sales@azic.com

ARIZONA INSTRUMENT LLC
3375 N Delaware St | Chandler, AZ
www.azic.com

Flow Rate	150 ml/min (0.15 liters/min)
Power Requirements	12 VDC for the instrument (provided by the internal battery, AC power supply/charger, external battery pack or car accessory cable 100-240VAC, 47-63Hz, 3.2A for the AC power supply/charger
Internal Battery Pack	Rechargeable nickel metal hydride (NiMH)
Dimensions	11" L x 6" W x 6.5" H
Weight	5.4 lbs.
Output	Digital: USB serial data to PC, printer or USB flash drive Analog: 4-20mA current loop (requires external power source) accurate to 0.3% of output
Warranty	1 year, factory parts and labor

ACCESSORIES

990-0217	Jerome Hard Carrying Case
990-0220	Jerome Soft Carrying Case
990-0225	10:1 Dilution Module
Y605-0901	Accessory Kit
Y605-0903	Maintenance Kit
Z2600 0918	Jerome Functional Test Module, 250 ppb, 115V
Y2600 0920	Functional Test Module (FTM) Accessory Kit
Z2600 0930	Jerome Functional Test Module, 30 ppb, 115V

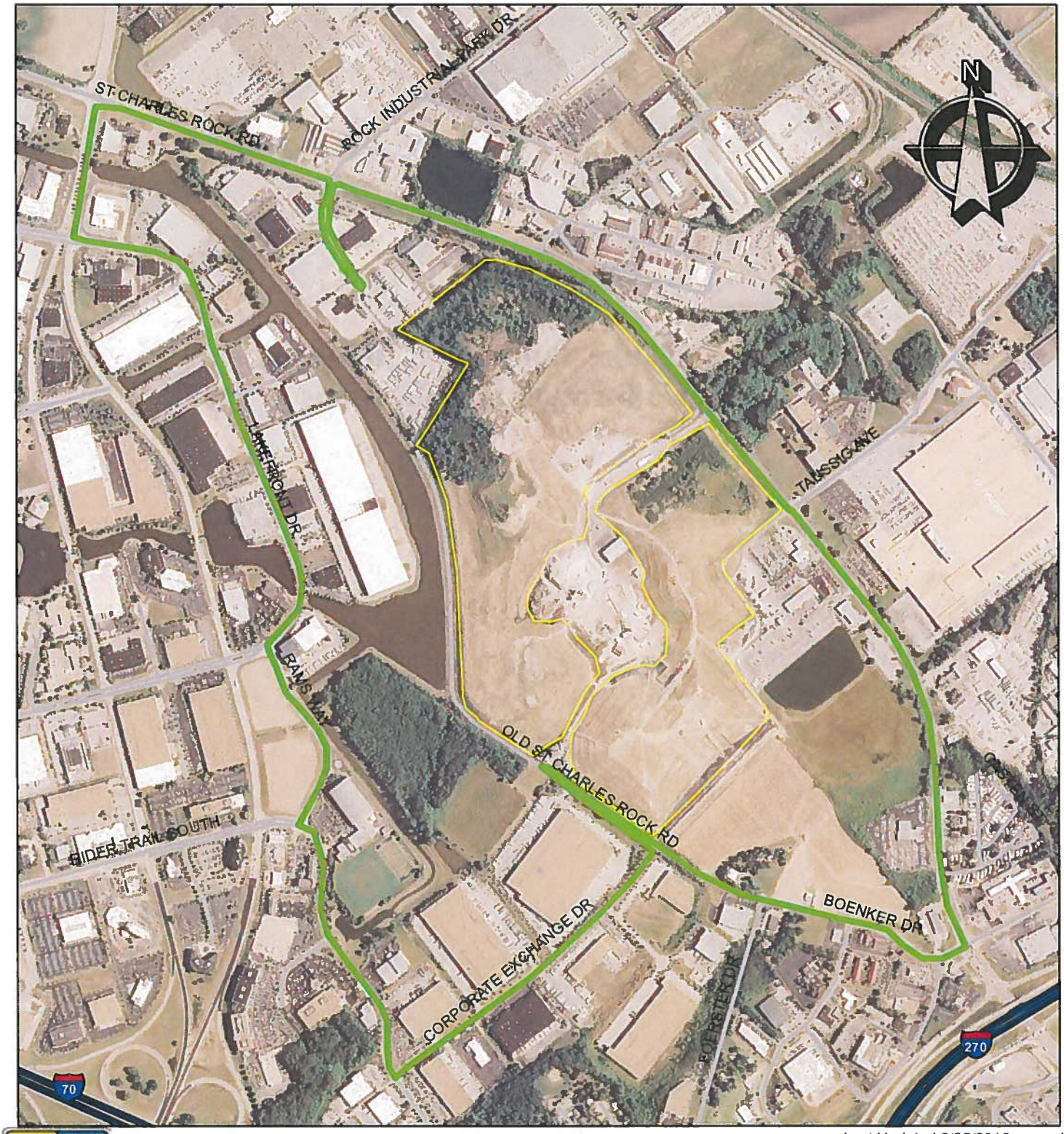
PARTS

200-0143	Battery Pack Assembly
200-0170	Car Accessory Cable Assembly
2600 3039	.25 Fritware (1 pack of 20 fritware filter)
990-0214	External Battery Pack
990-0219	USB Memory Stick
Z2600 3905	Zero Air Filter
Z2600 3930	Scrubber Filter
Z2600 3940	Chlorine Filter

ATTACHMENT D

Routine Air Monitoring Route Around Bridgeton Sanitary Landfill

Bridgeton Sanitary Landfill
Daily Benzene, Hydrogen Sulfide, and Odor Monitoring Path



Last Updated 3/25/2013 nrnorrd

Missouri Department of Natural Resources
Division of Environmental Quality
Solid Waste Management Program

0 375 750 1,500 Feet

Although data sets used to create this map have been compiled by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials.

Legend

- Daily Monitoring Path
- Waste Areas (approximate)

ATTACHMENT E

Sorbent Tube Sampling Equipment and Calibration Specifications

Publication 1735 Rev 1201

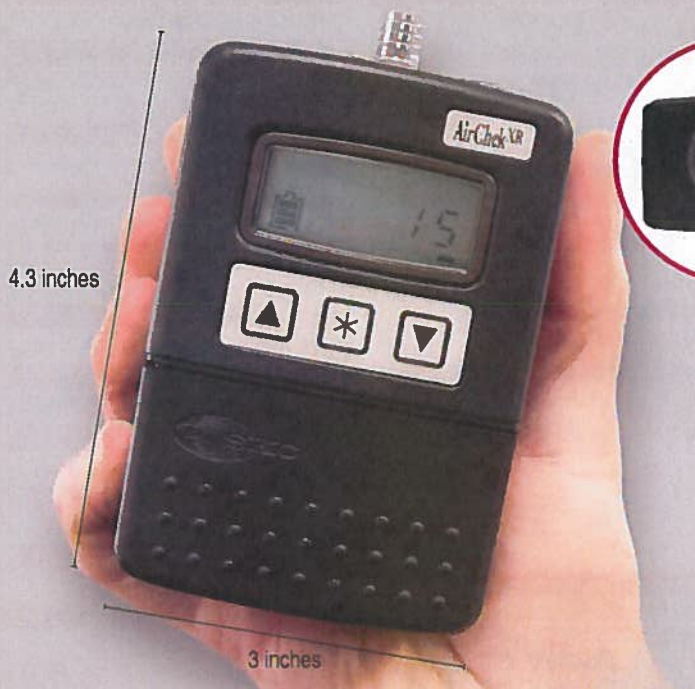
AirChek XR5000 Sample Pump

Supercharged Li-Ion Battery Power!

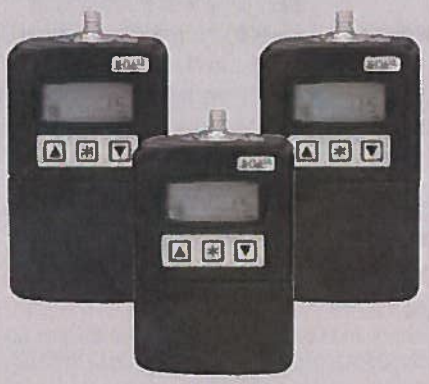
Flows: 5 to 5000 ml/min

Approvals

c UL us LISTED *Li-Ion models* CE



Top view



Three battery options

Extended flow range: 5 to 5000 ml/min†

- Suitable for low flow gas/vapor or high flow particulate sampling
- Optional low flow holder (low flow adapter kit, Cat. No. 210-500) used with CPC allows up to four tube samples to be taken simultaneously, each at different flow rates if desired

Enhanced battery power for extended run times*

XR5000 Model	2 L/min	5 L/min
High-power Li-Ion	40 hours	22 hours
Standard Li-Ion	20 hours	11 hours
Alkaline	18 hours	8 hours

* *Results of run time tests using 37-mm, 0.8-µm MCE filters with new pumps and batteries. Pump and battery performance may vary.*

Extended backpressure capabilities

- Up to 50 inches water at 2 L/min

Patented** highly accurate isothermal flow control system

Extremely simple to use

- Easy-to-use three-button keypad
- Set-and-go timer for timed and delayed runs to 9999 minutes
- Continuous run with the touch of a button
- Large LCD displays elapsed time and accumulated run time
- Bright blue status LED

Automatic features for sample integrity

- Flow correction for changes in temperature
- Lockable keypad
- Flow fault indicator
- Auto-restart from flow fault
- Accumulated run time display
- Battery status indicator

Three interchangeable battery options

- High-power Li-Ion for extended runs
- Standard Li-Ion for lighter weight
- Disposable AA alkaline batteries for fast emergency response

Standard model weighs only 16 ounces (454 grams)

Li-Ion models UL Listed for intrinsic safety

The first RoHS compliant sample pump!

- Components meet Euro directive for reduction of hazardous substances (including lead) to support green initiatives

** *U.S. Patent No. 5,892,160*

† *5 to 500 ml/min with Low Flow Adapter Kit*

SKC

SKC Inc. 724-941-9701 SKC West 714-992-2780 SKC Gulf Coast 281-859-8050 SKC South 434-352-7149

www.skcinc.com

AirChek XR5000 Sample Pump

The Supercharged power of Li-Ion!

Performance Profile	
Flow Control Accuracy	± 5% of set-point after calibration to desired flow
Timing Accuracy	1 min/mo at 25 C
Typical Run Time	***Li-Ion battery:*** ± 20 hrs (*see table on reverse*) ***Charger:*** Extended runs when attached to charger
Charge Time *(varies with capacity and level of charge)*	***Standard 2-cell Li-Ion:*** Approximately 4 hrs (*with approved charger*) ***High-power 4-cell Li-Ion:*** Approximately 8 hrs (*with approved charger*)
Temperature Range	***Operating:*** 32 to 113 F (0 to 45 C) ***Charging:*** 32 to 113 F (0 to 45 C) ***Storage:*** -4 to 95 F (-20 to 35 C)
Timer Display Range	1 to 9999 min (6.8 days); display rolls over to 0 upon reaching 9999 min
Auto-off	After 5 min of inactivity
Flow Fault	After 15 sec, pump stops, holds run time display, and displays fault icon. After 15 sec in fault, auto-restart is attempted every 15 sec up to 5 times
Low Battery Fault	15 sec to sleep

Ordering Information

AirChek XR5000 Pumps require 1/4-inch ID tubing.

AirChek XR5000 with High-power Li-Ion‡

Pump and Kits		Cat. No.
Pump with battery and screwdriver set, *requires charger, see kits or chargers below*		210-5001
Starter Kit includes pump, charger, Tygon tubing (3 feet, 1/4-inch ID), and collar clip with cable tie	100-240 V	210-5001-S
Single Pump Kit includes pump, charger, cassette holder, and soft-side nylon carry case	100-240 V	210-5001K
5-pack High Flow Pump Kit includes 5 pumps and cassette holders and Take Charge 5 Multi-charger, in a Pelican case	100-240 V	210-5001K5
5-pack High/Low Flow Pump Kit includes 5 pumps, cassette holders, adjustable low flow holders, constant pressure controllers, and Type A tube covers and Take Charge 5 Multi-charger, in a Pelican case	100-240 V	210-5001K5D
Replacement 4-cell Li-Ion Battery Pack		P85004

‡ *AirChek XR5000 pumps with Li-Ion batteries may be subject to special shipping regulations.*

AirChek XR5000 with Standard Li-Ion‡

Pump and Kits		Cat. No.
Pump with battery and screwdriver set, *requires charger, see kits or chargers below*		210-5002
Starter Kit includes pump, charger, Tygon tubing (3 feet, 1/4-inch ID), and collar clip with cable tie	100-240 V	210-5002-S
Single Pump Kit includes pump, charger, cassette holder, and soft-side nylon carry case	100-240 V	210-5002K
5-pack High Flow Pump Kit includes 5 pumps and cassette holders and Take Charge 5 Multi-charger, in a Pelican case	100-240 V	210-5002K5
5-pack High/Low Flow Pump Kit includes 5 pumps, cassette holders, adjustable low flow holders, constant pressure controllers, and Type A tube covers and Take Charge 5 Multi-charger, in a Pelican case	100-240 V	210-5002K5D
Replacement 2-cell Li-Ion Battery Pack		P85002

‡ *AirChek XR5000 pumps with Li-Ion batteries may be subject to special shipping regulations.*

Pump and Kits	Cat. No.
Pump with 6 AA batteries and screwdriver set	210-5003
5-pack High Flow Pump Kit includes 5 pumps and cassette holders, in a Pelican case	210-5003K5
5-pack High/Low Flow Pump Kit includes 5 pumps, cassette holders, adjustable low flow tube holders, constant pressure controllers, and Type A tube covers, in a Pelican case	210-5003K5D
Alkaline Battery Pack includes 6 alkaline batteries	P75715

Accessories		Cat. No.
Chargers		
Single	100-240 V	223-241
Take Charge 5 Multi-charger	100-240 V	223-441

Note: *Replacing batteries with non-approved battery packs voids any warranty and UL intrinsic safety approvals.*

SKC Limited Warranty and Return Policy

SKC products are subject to the SKC Limited Warranty and Return Policy, which provides SKC's sole liability and the buyer's exclusive remedy. To view the complete SKC Limited Warranty and Return Policy, go to http://www.skcinc.com/warranty.asp.

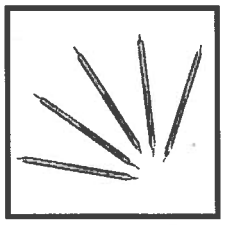
Quick View

Flow Rate (ml/min)
5 to 5000
Weight in Ounces (grams)
16 (454), 2 cell Li-Ion Model
Compensation Range (inches water)
Up to 10 at 5 L Up to 50 at 2 L
Built-in Timer/Clock
Timer
Constant Flow
Yes
Programmable
Yes
PC-compatible
N/A
Multi-tube Sampling
Yes
Flow Fault Feature
Yes
RFI/EMI Shielded
Yes
Intrinsically Safe — UL Listed
Yes (Li-Ion battery models only)
MSHA-approved Models Available
N/A
ATEX Models Available
N/A
CE Marked
Yes
RoHS Compliant
Yes
Corrects for Changes in Atmospheric Pressure
N/A
Corrects for Changes in Temperature
Yes
Battery Type
High-power Li-Ion (7.4 V, 4.4 Ah, 32.6 Wh) Standard Li-Ion (7.4 V, 2.2 Ah, 16.3 Wh) Alkaline - size AA, 1.5 V
Battery Check
Yes
Tubing
Requires 1/4-inch ID tubing

Recommended Accessories
Chargers
Defender Calibrator Cat. No. 717-510M
Low Flow Adapter Kit Cat. No. 210-500
Filter Holders
Tubing
Cases/Pouches
Adjustable Low Flow Holders

SKC® Application Guide

Sampling Train — Sorbent Sample Tubes



Sorbent tube sampling is the NIOSH/OSHA-approved method for collecting most hazardous gases and vapors from the air. The sorbent tube is glass with breakable end tips and contains a specially prepared high-activity sorbent. Most tubes have two sections: one for sample collection and the other for backup. This configuration provides a check against saturation of the primary sorbent bed. This Application Guide demonstrates how to set up a **Sampling Train Using Sorbent Sample Tubes**.

Required Equipment

1. An **air sampling pump** capable of sampling at the recommended flow rate with the sampling medium in line, such as:
   - SKC 210 Series Pocket Pump®
   - SKC 224-XR Universal Series Sampler with Adjustable Flow Holder Cat. No. 224-26 Series
   - SKC AirChek® 2000 Sampler with Constant Pressure Controller Cat. No. 224-26-CPC and Adjustable Flow Holder Cat. No. 224-26 Series
   - SKC AirChek 52 Sampler with Constant Pressure Controller Cat. No. 224-26-CPC and Adjustable Flow Holder Cat. No. 224-26 Series
   - SKC 222 Series Low Flow Sampler
2. An **air flow calibrator,** such as:
   - SKC UltraFlo® Calibrator Cat. No. 709
   - DC-Lite Flowmeter 717 Series
3. The **sorbent sample tube** specified in the method
4. The **appropriate tube holder** or protective tube cover

Optional Equipment

1. SKC **Tube Breaker** Cat. No. 222-3-50 (for 6- and 7-mm OD tubes) or 222-3-51 (for 8- and 10-mm OD tubes)

Introduction

The illustrations in this guide show sampling trains using SKC 224-XR Series Universal Constant Flow Samplers and 210 Series Pocket Pumps. If using a Universal Sampler, use an adjustable low flow holder for sampling at flow rates below 750 ml/min. A low flow holder is not necessary for flow rates greater than 750 ml/min. If using a low flow Pocket Pump, it is not necessary to use a low flow holder. To determine the correct flow rate for the chemical of interest, refer to the appropriate analytical method. See the operating instructions for the pump to ensure that it is capable of sampling at the correct flow rate.

1. Preparing the Sorbent Tube

Using a tube breaker, break off both ends of a sorbent tube to provide an opening of at least one-half the internal diameter. This tube will be used for calibrating the flow and not for collecting the sample.

2. Setting up the Sampling Train With Low Flow Holder — See Figure 1

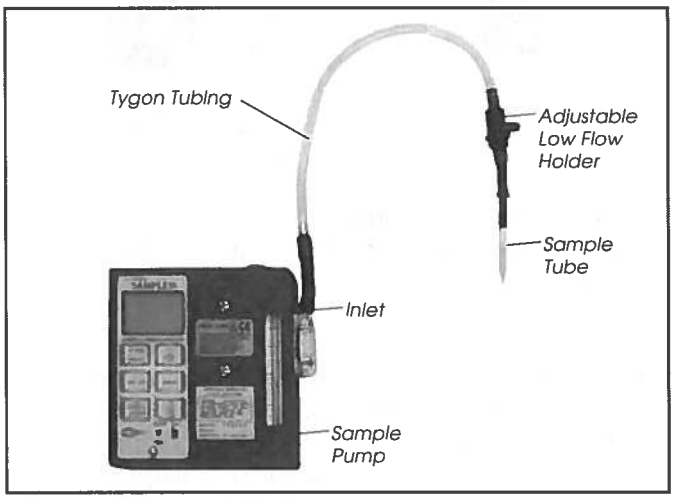


Figure 1. Sampling Train Using an Adjustable Low Flow Holder

If using a Universal Sampler, ensure that it is in the low flow mode. With flexible tubing, connect the low flow holder to the sampler inlet. Place the sorbent tube into the black rubber sleeve of the low flow holder. The printed arrow on the sorbent tube shows the direction of air flow and should point toward the sampler. If there is no arrow printed on the tube, insert the end of the tube with the smallest sorbent section (backup section) into the tube holder.

Publication 1168 Rev 0312

SKC Inc. 724-941-9701 **SKC South** 434-352-7149 **SKC Gulf Coast** 281-859-8050 **SKC West** 714-992-2780
www.skcinc.com

Sampling Train — Sorbent Sample Tubes

Without Low Flow Holder — See Figure 2

Using a low flow pump, connect flexible tubing from the pump inlet to the tube holder. Place the sorbent tube into the black rubber sleeve of the tube holder. The printed arrow on the sorbent tube shows the direction of air flow and should point toward the pump. If there is no arrow printed on the tube, insert the end of the tube with the smallest sorbent section (backup section) into the tube holder.

3. Calibrating the Flow Rate — See Figure 2

To calibrate the flow rate, connect the open end of the sorbent tube to an external flowmeter. Calibrate to the flow rate specified in the analytical method for the chemical of interest. See the pump and flowmeter operating instructions for calibrating the flow rate. When the flow rate has been calibrated and verified, remove the sorbent tube used to calibrate the flow and set it aside. This tube will be used to verify the flow rate after sampling. Record the pre-sample flow rate.

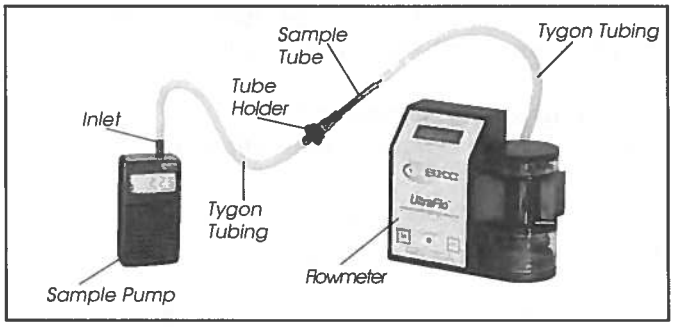


Figure 2. Sampling Train With a Tube Holder Connected to a Flowmeter

4. Sampling — See Figure 3

When ready to start sampling, break off both ends of a new sorbent tube in the same manner used for calibrating the flow. Insert the sorbent tube into the rubber sleeve of the low flow holder or tube holder with the smallest sorbent section in the holder. Place the protective cover over the sorbent tube, and attach the clip to a worker's collar and the pump to the worker's belt. The sorbent tube should be placed in a vertical position during sampling. Turn on the pump and note the start time and any other sampling information.

5. After Sampling

At the end of the sampling period, turn off the pump and note the ending time. Remove the sorbent tube, seal the ends of the tube with the caps provided, and record pertinent sampling information.

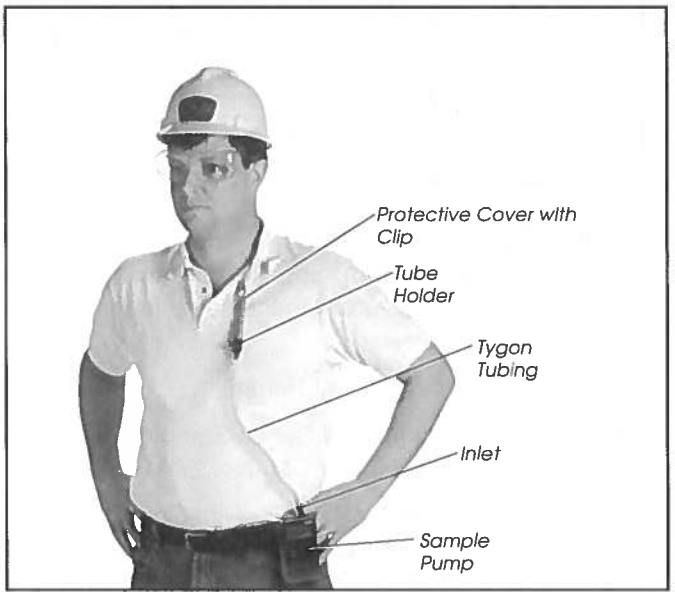


Figure 3. Worker Wearing Pocket Pump with a Sampling Train

Using a flowmeter, calibrate the flow rate with a representative sorbent tube in line to verify that the flow has not changed by more than 5%.

Submit field blanks from the same lot number as the sample tubes. Field blanks should be subjected to exactly the same handling as the samples (break, seal, and transport) except that no air is drawn through them.

Pack the sample sorbent tubes, field blanks, and all pertinent information securely for shipment to a laboratory for analysis.

Publication 1168 Rev 0312

SKC Inc. 724-941-9701 **SKC South** 434-352-7149 **SKC Gulf Coast** 281-859-8050 **SKC West** 714-992-2780
www.skcinc.com

SKC® Application Guide

Calibrating a Pump Using a DC-Lite Flowmeter

In air sampling, determination of airborne concentrations requires an accurate knowledge of the volume of air sampled. Two important factors that affect air volume are constancy of pump flow rate and equipment reliability. It is important to calibrate the flow of the sampling pump to ensure the most accurate air volumes and determinations. This Application Guide describes **Calibrating a Pump Using a DC-Lite Flowmeter**. For calibrating using a film flowmeter (non-electric), refer to Publication #1163. For calibrating using electronic soap film calibrators, refer to Publication #1366.

Required Equipment

1. An **air sampling pump** capable of sampling at the recommended flow rate with the sampling medium in line, such as:
   - SKC 210 Series Pocket Pump®
   - SKC 224-XR Universal Series Sampler (low flow applications require the 224-26 Series Adjustable Low Flow Holder)
   - SKC AirChek® 2000 Sampler (low flow applications require Constant Pressure Controller Cat. No. 224-26-CPC and the 224-26 Series Adjustable Low Flow Holder)
   - SKC AirChek 52 Sampler (low flow applications require Constant Pressure Controller Cat. No. 224-26-CPC and the 224-26 Series Adjustable Low Flow Holder)
2. A **DC-Lite Flowmeter** 717 Series model with the applicable flow range
3. The **Sampling medium** specified in the method
4. Any **additional equipment** specified in the method

Introduction

This Application Guide provides general information about calibrating an air sampling pump using the DC-Lite Flowmeter. For specific details about the operation of a particular calibrator or sample pump, refer to the operating instructions.

1. Calibrating the Flow Rate

Prepare an appropriate sampling train as specified in the sampling method. Turn on the pump and press the ON button on the DC-Lite Flowmeter (Figure 1). Ensure that the pump is in the appropriate mode (high or low flow) for the desired flow rate and that any necessary flow accessories (such as pressure controllers) are in place.

Using flexible tubing, connect the outlet of a representative sampling medium (filter cassette, sorbent tube, etc.) to the inlet of the pump. Use a second length of flexible tubing to connect the inlet of the sampling medium to the lower outlet port of the DC-Lite Flowmeter (Figure 2). For accurate measurements, make this connection with the shortest tubing length possible. Avoid kinks and bends in the tubing.

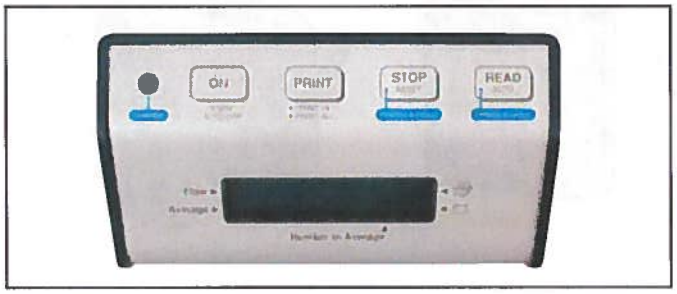


Figure 1. Top Panel Buttons of DC-Lite

Note: The DC-Lite Flowmeter has two fittings, an inlet for pressure applications and an outlet for pump or suction applications. Refer to the calibrator operating instructions for the proper selection.

SKC Inc. 724-941-9701 **SKC South** 434-352-7149 **SKC Gulf Coast** 281-859-8050 **SKC West** 714-992-2780
www.skcinc.com

Calibrating a Pump Using a DC-Lite Flowmeter

Press the READ button on the DC-Lite once to obtain a single flow measurement (see Figure 1). Repeat this process for a minimum of three readings to accurately determine flow rate. The DC-Lite will also display average flow measurement for up to 10 readings, then the average will reset. To take auto-repeat readings, press and hold the READ button until a reading starts, then release it. Allow three or more readings (up to 10) to occur, then press the STOP button once. The DC-Lite provides a flow reading and an average reading. If the reading displayed on the DC-Lite is not the desired flow rate, press and hold the STOP button to reset the display and press and hold the READ button until a reading starts; then release it. Adjust the flow control on the pump until the appropriate flow rate is displayed. Repeat a minimum of three readings to verify flow. Record this flow rate as the pre-sample flow rate.

2. Setting up the Sampling Train

When ready to begin sampling, remove the calibrator and representative sampling medium from the calibration train. Set these aside to verify flow after sampling. Place a new sampling medium of the same type into the train.

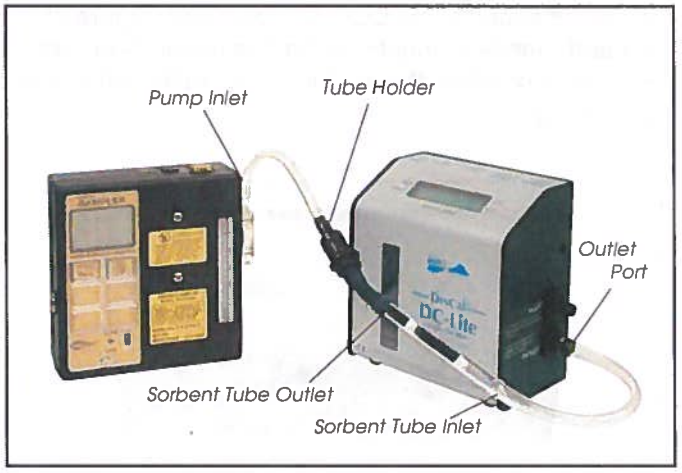


Figure 2. Calibration Train With a Sorbent Sample Tube

3. Sampling

Attach the sampling medium to a worker's clothing in the breathing zone and the pump to the worker's belt. Activate the pump and note sampling start time.

4. After Sampling

At the end of the sampling period, turn off the pump and note the ending time. Remove the sampling medium and seal it.

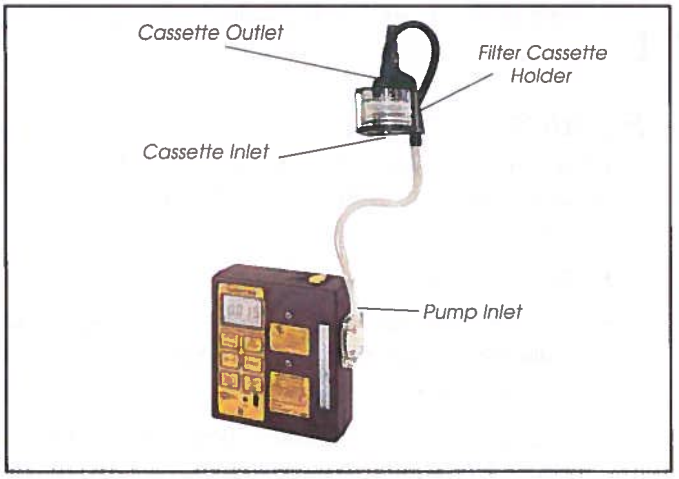


Figure 3. Sampling Train With a Filter Cassette

5. Verifying Flow

Reattach the representative sampling medium and the DC-Lite Flowmeter to the sampling train. Take three flow readings as outlined in step 1. Do not adjust the flow rate of the pump. Record this value as the post-sample flow rate. Compare the pre-sample and post-sample flow rates to ensure that the two rates do not differ by more than 5%. Report the average of the pre-sample and post-sample flow rates to the laboratory along with the sample time and other relevant data.

6. Sample Transport

Send the sealed sampling medium, blanks, and pertinent sampling information to a laboratory for analysis.

Publication 1555 Rev 0312

SKC Inc. 724-941-9701 **SKC South** 434-352-7149 **SKC Gulf Coast** 281-859-8050 **SKC West** 714-992-2780
www.skcinc.com

ATTACHMENT F

High-Volume PUF Sampling Equipment and Calibration Specifications

CleanAir

CleanAir Instrument Rental
500 W. Wood Street
Palatine, IL 60067-4975
800-553-5511
www.cleanair.com

GMW Model GPS1 PUF Sampler

The Sampler Includes:

- Sampler
- Sampling Module w/Glass Cartridge
- Exhaust Hose
- Manual
- Shipping Container

Specifications:

- Motor HP: 0.6
- Amperage: 8.0 Max
- Wattage: 960 Max
- Max Flow Rate: 280 lpm
- Power Source: 115V, 1 phase, 60 Hertz
- Dimensions: 52½" (H) 15" (W) x 18¾" (D)
- Net Weight: 65 lbs

Rental/Application Notes:

- This unit complies with U.S. EPA Method TO4, "Method for the Determination of Organochlorine
- Pesticides and Polychlorinated Biphenyls in Ambient Air".
- Don't forget to ask for a calibration kit if you need one. It is an optional item.
- Extra sampling modules are available for rent.
- We do not supply the filter or PUF sample media.
- When renting, equipment must be returned in its original packaging.

OPERATING INSTRUCTIONS
MODEL PS-1

A. UNIT PREPARATION.

Contents of two boxes:

Shelter box: 46" x 20" x 23"

GPS1-1	Dual sampling module
GPS1-6	Flow selector / elapsed time indicator
GPS1-7	Seven day mechanical timer
GPS1-8	Magnehelic gauge
GPS1-9	Flow venturi
GPS1-11	Blower motor assembly
GPS1-15	Exhaust hose
GPS1-19	Anodized aluminum shelter

Lid box: 20" x 15" x 15"

G10291	Shelter lid

Assembly instructions:

1. Remove the PS-1 PUF Sampler from the shipping carton.

2. Locate the shelter lid and install on the aluminum shelter as follows:
   a. Align the hinges of the lid to the rear of the shelter and fasten with four (4) 10-24 x 1/2" pan head screws.
   b. Secure the front catch, (see figure A) to the shelter front using two (2) 10-24 x 1/2" flat head screws.
   c. Secure the rear catch to the shelter back panel using one (1) 10-24 x 1/2" pan head screw.
   d. Secure the rear lid clasp to the shelter lid using two (2) 10-24 x 1/2" pan head screws. Note: These three catches may need readjustment to operate the shelter lid properly.
   e. Adjust the front and rear catches to be sure that the lid slot lowers over the front catch when closing the lid and aligns with the rear catch when the lid is in the open position.
   f. The lid can now be secured in an open or closed position with the aluminum strip or a padlock.

3. Find one (1) sampling module in the packing container and install on the inlet port. The inlet port has a 1/2" threaded male fitting. Place the module over the male fitting and screw it on until snug.

4. Pull the exhaust hose from out of the shelter bottom and extend it away from the shelter on the ground.

5. Open the shelter door and timer.

6. Prepare the timer for the desired start and stop times.

B. Unit Calibration.

1. Calibration of the PUF Sampler is performed without a foam slug or filter paper in the sampling module. However, the empty glass cartridge must remain in the module to insure a good seal through the module.

2. Install the G40 Calibrator on top of the 4" filter holder.

3. Connect an 8" water manometer to the Calibrator.

4. Open the ball valve fully.

5. Turn the system on by tripping the manual switch on the timer. Allow a few minutes for warm-up.

6. Adjust the voltage control screw to obtain a reading of 70 inches on the dial gage, (Magnehelic Gage).

7. With 70 inches on the dial gage as your first calibration point, record it and the manometer reading on the data sheet.

8. Close the ball valve slightly to readjust the dial gage down to 60 inches. Record the figure and manometer reading on the data sheet.

9. Using the above procedure, adjust the ball valve for readings at 50, 40, and 30 inches and record on the data sheet.

10. Using these two sets of readings, plot a curve on the data sheet. This curve will be used for determining the actual flow rate in the field.

11. Re-adjust the voltage control fully clockwise to maximum setting. Open ball valve fully.

C. Unit Operation.

1. The PUF Sampler may be operated at ground level or on rooftops. In urban or congested areas, it is recommended that the sampler be placed on the roof of a single story building. The sampler should be located in an unobstructed area, at least two meters from any obstacle to airflow. The exhaust hose should be stretched out in a down wind direction if possible.

2. The sampler should be operated for 24 hours in order to obtain average daily levels of airborne pesticides.

3. on and off times and weather conditions during sampling periods should be recorded. Air concentrations may fluctuate with time of day, temperature, humidity, wind direction and velocity and other climatological conditions.

4. Air flow-readings should be taken (dial gage) at the beginning and end of each sampling period. Differences between the beginning and ending flow rates should be averaged out to obtain an overall flow rate. (The PUF Sampler can be fitted with a gas meter which would give a direct reading of the total flow.)

5. Blower motor brushes should be inspected frequently and replaced before expending.

6. An electrical source of 110 volts, 15 amps is required.

D. Descriptions of Sampling Media (Sorbents)

1. Two types of sampling media are recommended for use with the PUF Sampler: polyurethane foams and granular solid sorbents. Foams may be used separately or in combination with granular solids. The sorbent may be extracted and reused (after drying) without unloading the cartridge.

2. Polyurethane Foam (PUF):
   a. Use polyether-type polyurethane foam (density No. 3014, 0.0225 grams/cm3, or equivalent). This is the type of foam generally used for furniture upholstery, pillows, and mattresses.(General Metal Works' part number PS1-16 is recommended. It is a 3" PUF plug. Also available are two and one inch pieces.) This type of foam is white and yellows on exposure to light.

3. Granular Solids:
   a. Porous (macroreticular) chromatography sorbents recommended. Pore sizes and mesh sizes must be selected to permit air flow rates of at least 200 liters/minute. Approximately 25 cm3 of sorbent is recommended. The granular solids may be sandwiched between two layers of foam to prevent loss during sampling and extraction.

E. Sampling Module.

1. Release the three (3) swing bolts on the 4" filter holder (FH-2104) and remove the hold down ring.

2. Install a clean 102mm dia. glass fiber filter (GMW-0232) on the support screen and secure it with the hold down ring and swing bolts.

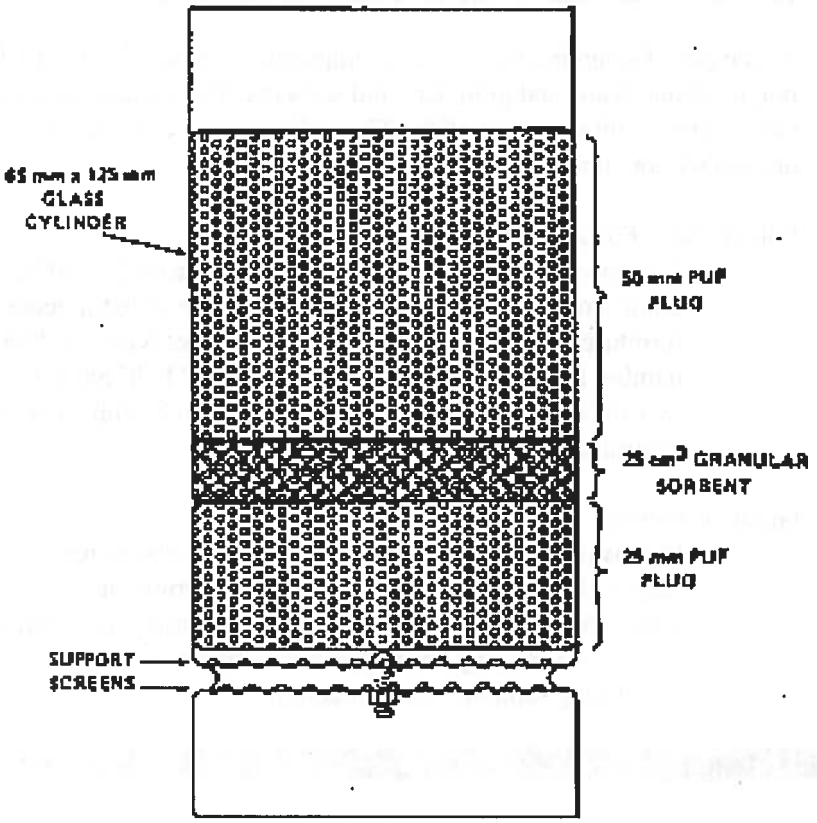
3. Unscrew together the 4" filter holder and the sampling module cap leaving the module tube in place with the glass cartridge exposed.

4. Load the glass cartridge with foam and or foam/granular solids and replace in the module tube. Fasten the glass cartridge with the module cap and 4" filter holder

assembly while making sure that the module assembly, 4" filter holder and all fittings are snug and not over tighten.

5. The glass cartridge and glass fiber filter should be removed from the sampler with forceps and clean, gloved hands and immediately placed in' a. sealed container for transport to the laboratory. Similar care should be taken to prevent contamination of the filter paper and vapor trap (foam) when loading the sampler.

6. It is recommended to have two (2) sampling modules for each sampling system so that filter and foam exchange can take place in the laboratory.



DUAL SORBENT VAPOR TRAP

ATTACHMENT G

Tedlar Bag Sampling Equipment Specifications

AC'SCENT®
Vacuum Chamber

- Sensible design and easy to use
- Portable and convenient
- 23.25 x 20.75 x 7.75"
- 5.5 x 9" window in lid for viewing
- Heavy duty, vacuum tight case
- Accommodates up to 20 liter size bags
  -larger 40 liter size case available
- Integral pump powered by 4 D-size batteries
  - no additional sample pump is needed
- Direct filling of sample bag using negative pressure
  - no pump contamination
- 2 L/min vacuum filling of sample bag
- Includes: step-by-step instructions
  tubing connectors
  4 D-size batteries
- Designed to be used with 1/4"OD, 3/16"ID Teflon tubing and 1/4"OD, 1/8"ID Silicone tubing.

Ideal for collecting air samples

US$1,275

For more information on the
***VAC'SCENT®* Air Sampling Vacuum Chamber**
or other odor sampling
and testing products,
contact a representative at
1-800-879-9231 ext. 20
or visit
www.fivesenses.com

St. Croix Sensory, Inc. 3549 Lake Elmo Ave. N., P.O. Box 313 Lake Elmo, MN 55042
1-800-879-9231 Fax 651-439-1065 stcroix@fivesenses.com

Set-up

1. With the vacuum chamber open, place the Tedlar sample bag into chamber.
2. Connect the bag to the inside of the Sample Valve **(D)** with the tubing.
3. Open sample bag valve.
4. Insert 4 D-size batteries.
5. Turn on Pump.
6. Close vacuum chamber - close all four latches.
7. Insert the provided Hose Barb Connector with 1" silicone tubing into the outside of the Sample Valve **(D)**, then connect a sufficient amount of a PTFE (Teflon) Tubing to the 1" silicone tubing (the silicone will act as a coupling between the PTFE Tubing and the hose barb connector).
   This becomes the Sample Line.

Fill the Bag for Conditioning

8. Connect the Pump Inlet Valve **(B)** to the Chamber In/Out Valve **(C)** with the Silicone Tubing Connector Line. This will begin the filling of the bag.
9. The sample will begin collecting through the Sample Line.
10. Fill the bag 1/4 to 1/2 full.

Empty the Bag

11. Disconnect the Silicone Tubing Connector Line from the Pump Inlet Valve **(B)** and attach it to the Pump Outlet Valve **(A)**. This will pressurize the chamber and deflate the bag through the Sample Line **(D)**,
    -the tubing connector must be in **(D)** to open the valve and deflate the bag.
12. Empty the bag completely.

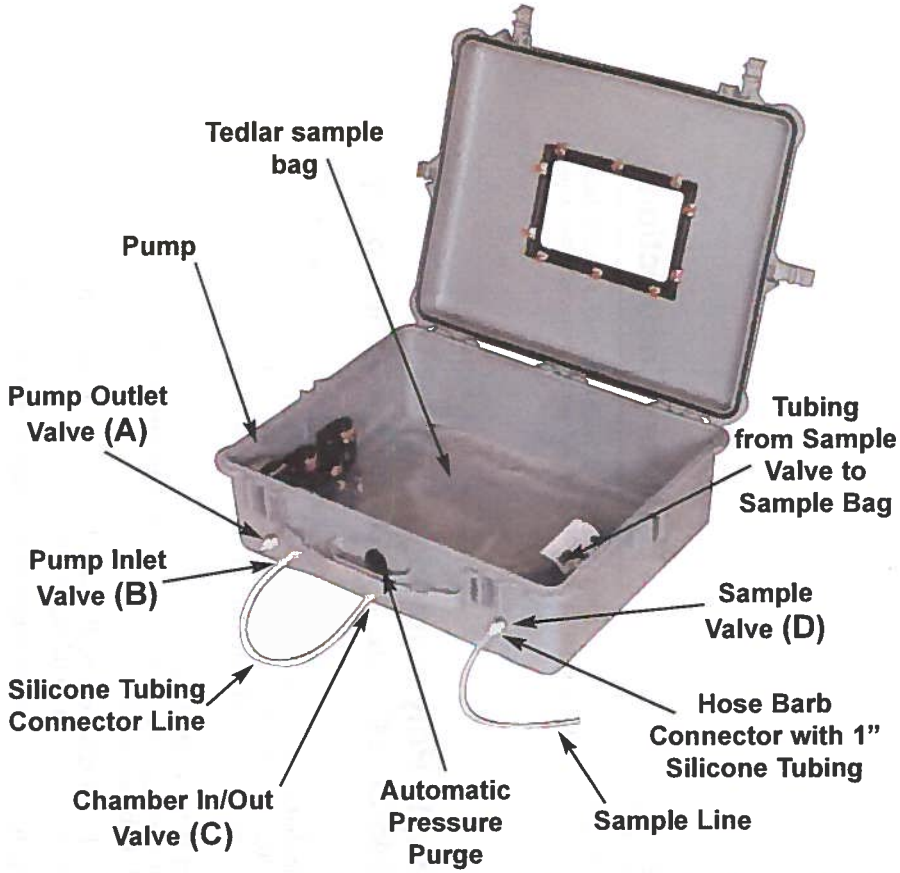
Prime the Sample Line

13. Disconnect the Silicone Tubing Connector Line from the Pump Outlet Valve **(A)**.
14. Disconnect the tubing connector with the Sample Line from the Sample Valve **(D)** and attach it to the Pump Inlet Valve **(B)**.
15. Wait for a sufficient amount of time (15-30 sec.) for the Sample Line to fill with odor from the sample location
    [thus, removing non-sample air from the Sample Line].
16. Disconnect the tubing connector with the Sample Line from the Pump Inlet Valve **(B)** and reattach to the Sample Valve **(D)**.

Collecting a Sample

17. Attach the Silicone Tubing Connector Line to the Pump Inlet Valve **(B)**
    -the other end should still be attached to the Chamber In/Out Valve **(C)**.
18. Fill the bag 3/4 full.
19. When the bag is 3/4 full, disconnect the tubing connector with the Sample Line from Sample Valve **(D)**.
20. Due to the negative pressure in side the chamber, it will be difficult to open. To de-pressurize the chamber, disconnect the Silicone Tubing Connector Line from the Pump Inlet Valve **(B)** and connect to Pump Outlet Valve **(A)**.
    * **Be sure that the Sample Line from Sample Valve (D) has been disconnected or you will begin to empty the bag.**
21. Within a few seconds, you will be able to open the chamber.
22. Close the bag valve.
23. Turn the Pump off.
24. Remove the bag from the vacuum chamber.
25. *Depending on the quality of the air being sampled, replacement of PTFE and Silicone tubing on the Sample Valve (D) may be necessary between samples.*

VAC'SCENT Operating Instructions



If you have any questions, Call: 1-800-879-9231

St. Croix Sensory, Inc.

www.fivesenses.com

3549 Lake Elmo Ave. N.
P.O. Box 313
Lake Elmo, MN 55042
Phone 651-439-0177
1-800-879-9231
Fax 651-439-1065
e-mail: stcroix@fivesenses.com

Operating Instructions

863 Valley View Road, Eighty Four, PA 15330 USA
Tel: 724-941-9701 Fax: 724-941-1369 e-mail: skctech@skcinc.com

Single Polypropylene Fitted Bags
232, 236, 245-2x, 247, 252, and 262 Series Sample Bags

The 232, 236, 245-2x, 247, 252, and 262 Series sample bags feature a single polypropylene fitting that is used for both filling the bag and removing the sample for analysis. The fitting contains both a syringe port with PTFE-lined septum and a hose connection and acts as a shut-off valve for the hose connection.

Guidelines for Bag Sampling

1. **Ensure that the bag material and fittings are appropriate for the compounds to be sampled.**
2. Use only PTFE tubing to connect the sample bag to the pump to prevent sample loss by adsorption on tubing walls.
3. Before using, flush the bag thoroughly with purified air or nitrogen.
4. Analyze the sample within 24 to 48 hours. Long-term storage of air-contaminant mixtures in bags is not recommended.
5. Do not ship sample bags by air unless the cargo cabin is pressurized.

Cautions

Maximum Operating Temperature
Do not exceed these specifications.

- **232, 245-2x, 247, 252, and 262 Series Bags:** 200 F (93.3 C) due to fitting material temperature rating. Do not place undue mechanical strain on fitting at maximum temperature.
- **236 Series Bags:** 140 F (60 C) due to the SamplePro® FlexFilm bag material temperature rating

Do not use sample bags to sample compounds with boiling points > 249.8 F (121 C).

SKC sample bags are designed for sampling air at atmospheric pressure only. Attempting to pressurize the bag can result in bag rupture and sample loss. Do not ship bag samples by air freight in non-pressurized cargo cabin. Bags can burst under such conditions.

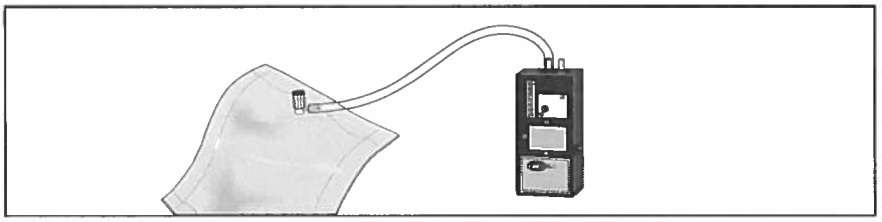
All federal and state packaging and transporting regulations apply.

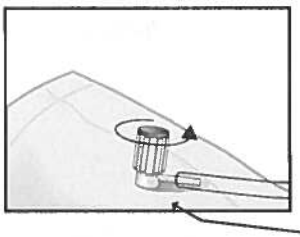
Failure to follow warnings and cautions voids any warranty.

Sample bags are designed for single use only.

Operation

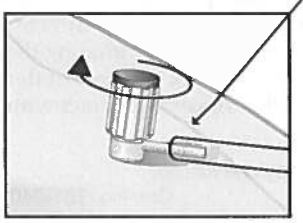
1. Flush the bag at least 3 times with purified air or nitrogen before use.
2. To fill a bag, connect PTFE tubing from the exhaust port of an air sample pump to the hose connection on the bag (stem protruding from the side of the fitting).





3. To open the shut-off valve, hold the side stem and turn the entire upper portion of the fitting (including the brown syringe port and the white section to which it is attached) counterclockwise one revolution. Turn on the pump and sample (*see Proper Bag Inflation*).

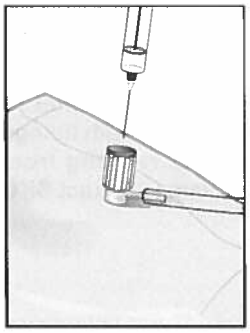
CAUTION: Do not turn side stem.



Do not sample compounds that exceed the 200 F (93.3 C) temperature rating of the polypropylene fitting material.

When using 236 Series SamplePro FlexFilm bags, do not sample compounds that exceed 140 F (60 C) temperature.

Do not use sample bags to sample compounds with boiling points > 249.8 F (121 C).



4. When sampling is complete, turn off the pump. To close the shut-off valve, hold the side stem and turn the entire upper portion of the fitting (including brown syringe port and the white section to which it is attached) clockwise until it is snug.
5. To withdraw samples using a needle and syringe, carefully insert the needle into the septum port in the center of the brown cap and pierce the septum.

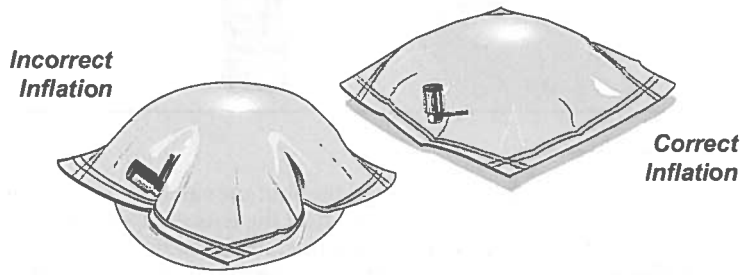
Do not allow the needle to puncture the bag material when piercing the septum.

Valves

SKC bag fitting valves are extremely durable but are not intended for use as handles or hanging devices. This type of handling may damage the seal causing leakage. It is considered to be misuse and will void the SKC warranty.

Proper Bag Inflation

Avoid filling any bag more than 80% of its maximum volume. At the end of the sampling period, turn off the pump and close the valve on the bag.



Filling Bags Using Negative Pressure

The SKC Vac-U-Chamber is a rigid air sample box that allows the direct filling of an air sample bag using negative pressure provided by most personal air sample pumps. When using the Vac-U-Chamber, the air sample enters the bag directly, without passing through the pump. This eliminates the risk of contaminating the pump or sample. The Vac-U-Chamber has rigid walls that will not collapse under vacuum conditions, thus eliminating possible errors. All surfaces in contact with samples are constructed of inert materials.

Small Vac-U-Chamber *(supplied without pump)* with polypropylene fittings; suitable for use with 1-liter bags ..... Cat. No. 231-940

Large Vac-U-Chamber (*supplied without pump*) with stainless steel fittings; suitable for use with 8-liter bags ..... Cat. No. 231-939

See Accessories on page 4 for tubing.

SKC sample bags are available in Tedlar®, FluoroFilm FEP, SamplePro FlexFilm, SamplePro PVDF, Standard FlexFoil®, and FlexFoil PLUS with fittings made of stainless steel, polypropylene, or PTFE in sizes ranging from 0.5 to 100 liters. SKC also manufactures custom sample bags. Contact SKC at 724-941-9701 or skctech@skcinc.com.

For sample bag stability reports, visit www.skcinc.com/bags.asp.

Accessories

Replacement Septa, pk/10.....Cat. No. 232-01-RS

PTFE Tubing, fits over bag fitting and Grab Air pump exhaust,
3/16-inch ID, 1/4-inch OD ..... 10 feet....Cat. No. 231-9-23
PTFE Tubing, fits inside bag fitting,
1/16-inch ID, 1/8-inch OD ..... 10 feet....Cat. No. 231-9-21
PTFE Tubing, fits Vac-U-Chamber inlet and 222 pump exhaust,
1/4-inch ID, 5/16-inch OD..... 10 feet.....Cat. No. 231-937
50 feet.....Cat. No. 231-924
Twin Port Pocket Pump Tubing Adapter Kit includes two lengths of silicone tubing: 1/8-inch ID, 1/4-inch OD for bag fitting and 3/16-inch ID, 3/8-inch OD for pump fitting; use with Cat. No. 231-9-23 PTFE tubing (*above*)..... Cat. No. 231-926

For more product information or assistance with applications, contact SKC Technical Service at 724-941-9701 or skctech@skcinc.com.

SKC Limited Warranty and Return Policy

SKC products are subject to the SKC Limited Warranty and Return Policy, which provides SKC's sole liability and the buyer's exclusive remedy. To view the complete SKC Limited Warranty and Return Policy, go to http://www.skcinc.com/warranty.asp.

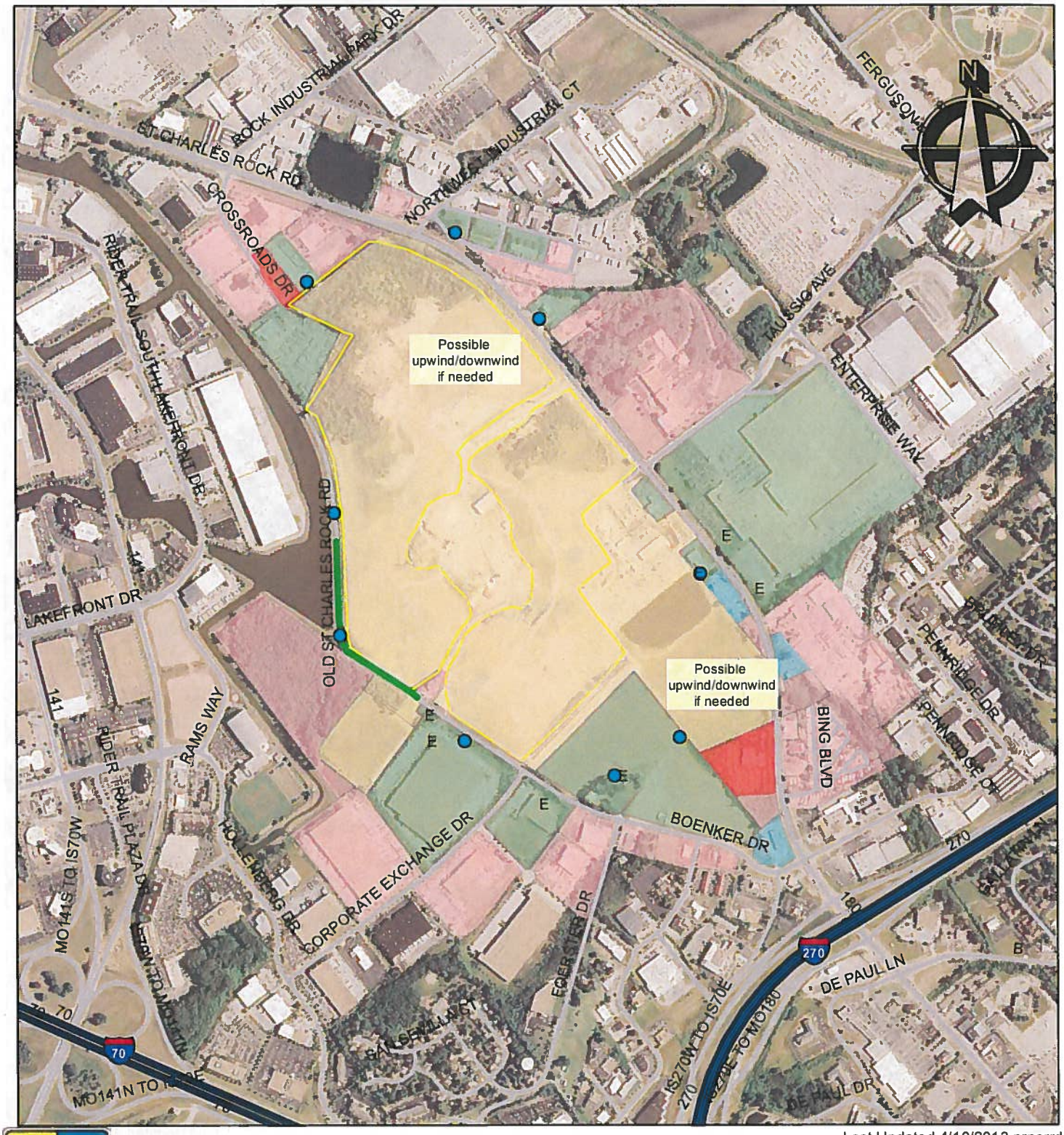
www.skcinc.com

Form 3781 Rev 1204

ATTACHMENT H

Potential Off-Site and On-Site Air Sampling Locations

Bridgeton Sanitary Landfill
Property Access Considerations



Last Updated 4/10/2013 nrnorrd

Missouri Department of Natural Resources
Division of Environmental Quality
Solid Waste Management Program

0 500 1,000 2,000 Feet

Although data sets used to create this map have been compiled by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials.

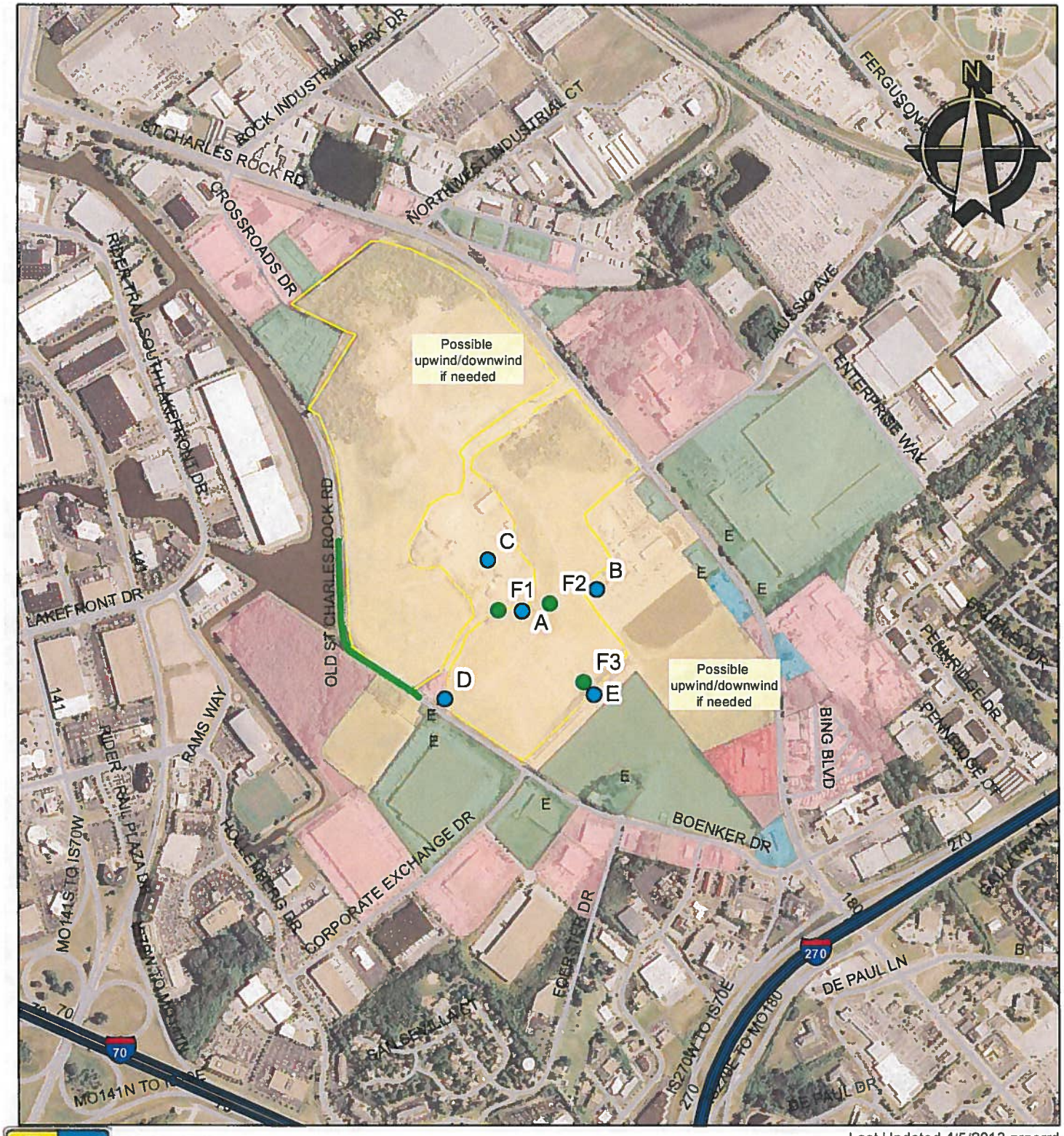
Legend

- Preferable off-site Locations
- Vacant Road Access
- Waste Areas (approximate)

Property Access

- No
- Parking Lot
- Republic
- Unknown
- Yes

Bridgeton Sanitary Landfill
Property Access Considerations



Last Updated 4/5/2013 nrnorrd

Missouri Department of Natural Resources
Division of Environmental Quality
Solid Waste Management Program

0 500 1,000 2,000 Feet

Although data sets used to create this map have been compiled by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials.

Legend

- Potential On-site Locations To Consider
- Anticipated FML Locations
- Vacant Road Access
- Waste Areas (approximate)

Property Access

- No
- Parking Lot
- Republic
- Unknown
- Yes

ATTACHMENT I

St. Croix Odor Parameters Overview

St. Croix Sensory, Inc.

A sensory testing and training company.

ODOR PARAMETERS

St. Croix Sensory specializes in quantification of perceived odors of air samples and commercial products and materials. Odors are the sensory perception caused by odorants (chemicals) stimulating olfactory receptors in the nose.

Odors can be quantified by five parameters that profile the human response. These parameters include: odor thresholds, odor intensity, odor persistency, hedonic tone, and odor characterization.

The following is a brief explanation of these parameters of the odor evaluation services provided by St. Croix Sensory. For environmental odor samples, an odorous air sample collected in a Tedlar air sample bag is evaluated. For product and material testing, the sample may also be from a Tedlar air sample bag or it may be a direct observation of a headspace developed around the sample or from an environmental test chamber.

Odor Thresholds

The most common measure of odors is the odor threshold value (OTV), also referred to as the odor concentration or odor strength. Odor strength is quantified by determining the amount of dilution needed to bring the odorous air sample to its threshold. The higher the threshold value, the more dilution is needed to bring the odor to threshold, thus the stronger the odor.

The odor threshold is determined by trained human assessors observing presentations of the odorous air sample dynamically diluted with an olfactometer. The testing procedures follow ASTM International E679-04, *Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits*, and EN13725:2003, *Air Quality – Determination of Odour Concentration by Dynamic Olfactometry*. EN13725, the official standard of all European Union countries, exceeds the requirements of ASTM E679-04. The standardization organizations of Australia and New Zealand have also adopted an identical standard (AS/NZ 4323.3-2001).

PO Box 313 • 3549 Lake Elmo Avenue N. • Lake Elmo, MN 55042
1.800.879.9231 • [P] 651.439.0177 • [F] 651.439.1065 • www.fivesenses.com • www.nasalranger.com

These testing standards utilize a presentation method called "3-alternative forced-choice" (3-AFC) or "triangular forced-choice (TFC). Each assessor performs the odor evaluation task by sniffing diluted odorous air from the olfactometer. The assessor sniffs three sample presentations; one contains the diluted odor while the other two are "blanks" (odor-free air). They must then select the one of the three that is "different" from the other two. The assessor is required (forced) to choose one of the three and acknowledge their response as a "guess", "detection", or "recognition", as defined by ASTM E679-04.

After the first set of presentations, the assessor is then presented with the next dilution level. At this next level, the assessor is again presented with three sample choices, one of which is the diluted odor sample. However, this next dilution level presents the odor at a higher concentration (i.e. two times higher). This is one-half the dilution ratio (fewer number of dilutions = higher concentration). The first dilution level presented to the assessors is below the odor threshold (subthreshold). The assessor proceeds to higher levels of sample presentation following these methods until the odor concentration is above the recognition threshold. This statistical approach is called "ascending concentration series."

Results are computed for each assessor based on the dilution levels where correct "detection" or "recognition" responses are recorded. The responses of all assessors are averaged to determine the sample's detection and recognition thresholds.

The dynamic dilution of an odorous emission is the physical process that occurs in the atmosphere down-wind of the odor source. An individual, or citizen from the community, observes the diluted odor. The dilution ratio is an estimate of the number of dilutions needed to make the actual odor emission just detectable. This is known as the Detection Threshold (DT). The Recognition Threshold (RT) is the dilution ratio at which the assessor first detects the odor's character ("smells like…"). The recognition threshold value is always lower than the detection threshold value. It takes more dilution to bring an odor to its detection threshold (no odor present) compared to its recognition threshold (odor is not recognizable).

The odor threshold is reported as a dimensionless dilution ratio; however, often the pseudo-dimensions of "Odor Units' (O.U.) are used. Units of "Odor Units per cubic meter" ($O.U./m^3$) are also commonly applied in order to calculate odor emission rates.

For this testing, St. Croix Sensory utilizes an AC'SCENT® International Olfactometer, a dynamic dilution triangle olfactometer, operating at 20-LPM with 5 assessors, who complete the threshold determination a minimum of two times (EN13725:2003). Final results are retrospectively screened in order to evaluate and identify assessors who may have a specific hypersensitivity or anosmia to the odor sample presented.

The assessors are tested and "certified" with a standard odorant (n-butanol) and are required to meet specific sensitivity criteria outlined in the European testing standard, EN13725. These assessors are required to have an average n-butanol detection threshold between 20-80 ppb based on their last 20 evaluations. Assessors also must maintain a

defined standard deviation of n-butanol threshold measurements in order to satisfy repeatability requirements of the standard.

St. Croix Sensory may utilize more assessors when necessary for a specific project. Furthermore, the AC'SCENT International Olfactometer is capable of operating from 3-LPM to 20-LPM if the client requires a specific flow rate that deviates from the EN13725 standard requirements.

Odor Intensity

Odor intensity is the relative strength of the odor above the Recognition Threshold (suprathreshold). The intensity of an odor is referenced on the ASTM Odor Referencing Scale described in ASTM E544-99, *Standard Practice for Referencing Suprathreshold Odor Intensity*. The IITRI Dynamic Dilution Binary Olfactometer (Butanol Wheel) is the dynamic presentation method St. Croix Sensory utilizes for the procedure of odor intensity referencing.

The odor referencing is accomplished by comparison of the odor intensity of the odor sample to the odor intensity of a series of concentrations of the reference odorant n-butanol. The Butanol Wheel olfactometer delivers the butanol in air to 8 glass sniffing ports that make-up a series of increasing concentrations of the butanol. The series starts at 12-ppm butanol and has an increasing concentration ratio of 2 (binary scale).

Each assessor observes the odorous air sample and determines the odor intensity. The average value of the panel of assessors is the reported intensity for the odor sample, expressed in units of parts per million (PPM) butanol equivalent. A larger value of butanol concentration means a stronger odor, but not in a simple numerical proportion, i.e. twice the butanol concentration does not mean twice the perceived odor intensity.

The Odor Intensity Referencing Scale serves as a standard method to quantify the intensity of odors for documentation and comparison purposes.

Odor Persistency ("Dose Response"):

Odor is a psychophysical phenomenon; the perceived odor intensity changes with concentration. Odor persistency is a term used to describe the rate at which the perceived intensity decreases as the odor is diluted, i.e. in the atmosphere down-wind from the odor source. The rate of change in intensity versus odor concentration is not the same for all odors.

The odor intensity is related to the odor concentration by the following equation (Steven's Law),

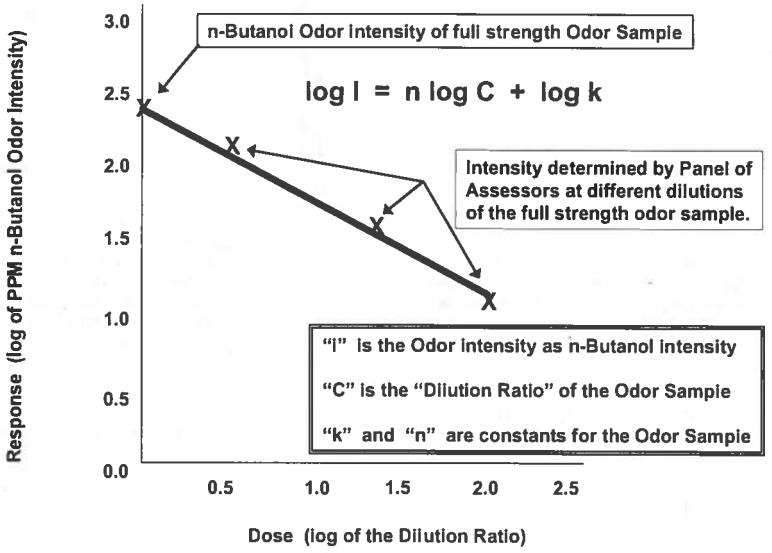
$I = k\,(C)^n$

Where:
I is the odor intensity expressed in ppm n-butanol,
C is the odor concentration expressed in number of dilutions (dilution ratio), and
k and n are constants that are different for every specific odorant or mixture of odorants.

This odor persistency relationship is a "Dose-Response" function (a psychophysical power function), which is linear on a log-log scale with the following equation:

$$\text{Log } I = n \text{ Log } C + \log k$$

The "Dose-Response" function is determined from intensity measurements of an odor at a minimum of three dilutions and possibly at the full strength concentration, utilizing ASTM E544, *Standard Practice for Referencing Suprathreshold Odor Intensity*. The plotted logarithmic values of the odor intensities and the odor dilution ratios (concentrations) create the "Dose-Response" function of the odor sample. The resultant straight line of the log-log plot is specific for each odor, with the slope of the line, n, representing relative persistency and the y-axis intercept, k, representing the full strength intensity. A flatter slope of an odorant mixture represents a more persistent odor.



This "Dose-Response", persistency, graph can be converted to a Power Law graph showing how the intensity changes with the odor concentration, represented in "Odor Units." This conversion is completed by taking the recognition threshold of the odorous air sample, the full strength odor concentration, into consideration.

The number of odor units presented at each diluted odor presentation can be determined by dividing the Recognition Threshold (RT) by the Dose-Response dilution ratio test points. For example, if the RT (full strength odor concentration) is 2000 O.U. and the

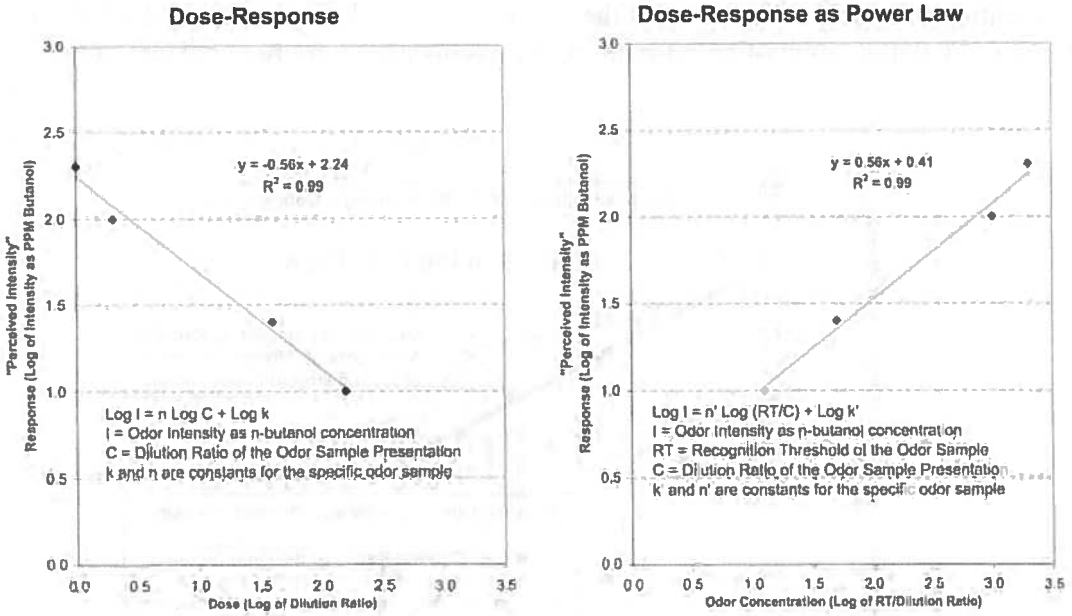
assessor is presented with this odor at 40 dilutions, then the assessor was presented with an odor that is equivalent to 50 O.U. The power law relationship can then be represented as:

Log I = n' Log (RT/C) + Log k'

This equation will have a positive slope. The slopes of the two curves are related by:

n = - n'

The following pair of graphs illustrates the example of an odor that has a recognition threshold of 2000 O.U. The assessors were presented with this odor sample at full strength and at dilutions of 2, 40, and 160.



The positive slope of the Power Law graph illustrates that the odor intensity of odorants increase as the mass concentration increases. The slope of the Dose-Response and Power Law graphs is less than one for most odors since it takes larger and larger increases in concentration to maintain a constant increase in perceived intensity.

Hedonic Tone HT

Hedonic Tone (HT) is a measure of the pleasantness or unpleasantness of an odor sample. An arbitrary but common scale for ranking odor by hedonic tone is the use of a 21 point scale:

+10	Pleasant
0	Neutral
-10	Unpleasant

The assigning of a hedonic tone value to an odor sample by an assessor is "subjective" to the assessor. An assessor uses her/his personal experiences and memories of odors as a referencing scale. The assessor, during training, becomes aware of their individual odor experience and memory referencing.

The average value of all assessors is the reported hedonic tone (HT) for the odor sample.

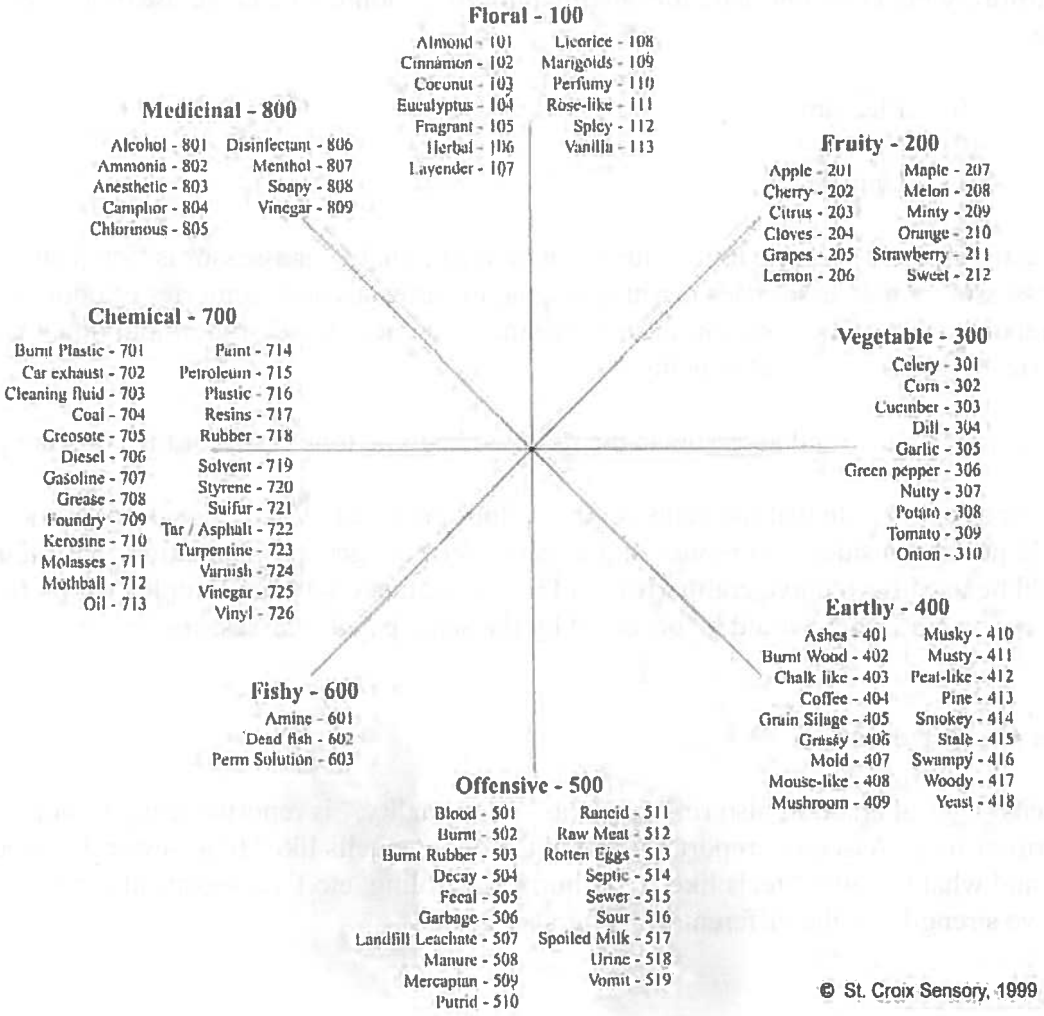
It is important to note that the hedonic tone values provided by the trained assessors should not be considered to represent the opinions of the general population. The values should be used for relative comparison of the pleasantness between samples within one test session since they would be observed by the same panel of assessors.

Odor Characterization

The character of an odor, also referred to as "odor quality," is reported using standard descriptor lists. Assessors report both what the odor "smells like" (e.g. sewer, banana, etc.) and what the odor "feels like" (e.g. burning, cooling, etc.) Assessors also report relative strengths of the different characters identified.

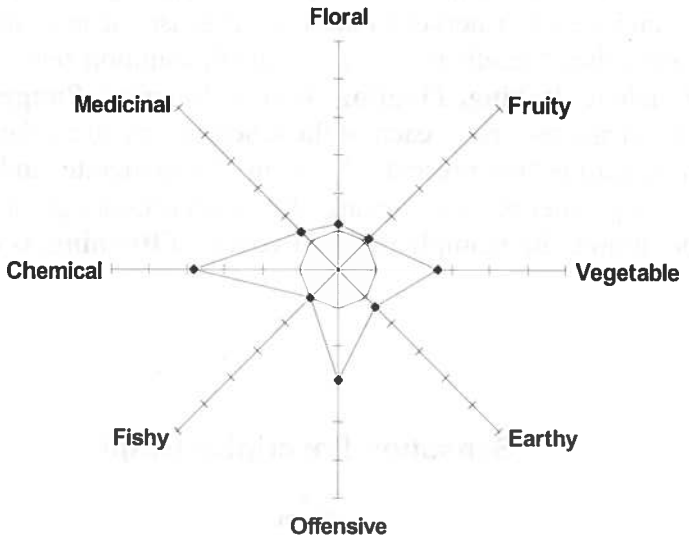
Odor Descriptors

Numerous "standard" *odor* descriptor lists are available to use as a referencing vocabulary. Eight (8) recognized odor descriptor categories, including **Vegetable, Fruity, Floral, Medicinal, Chemical, Fishy, Offensive, and Earthy,** are illustrated as an "odor wheel". Specific descriptors within each of these odor categories are presented in the subsequent diagram.



Each assessor rates these eight main odor descriptor categories on a relative strength scale of zero to five, where zero is "not present", 1 = faint, 3 = moderate, and 5 = strong. The average results of the panel of assessors are plotted on a spider graph (polar plot). The axis on the spider graph, for example in the direction of Offensive, is the average relative strength on the 0 to 5 scale.

Odor Descriptor Graph



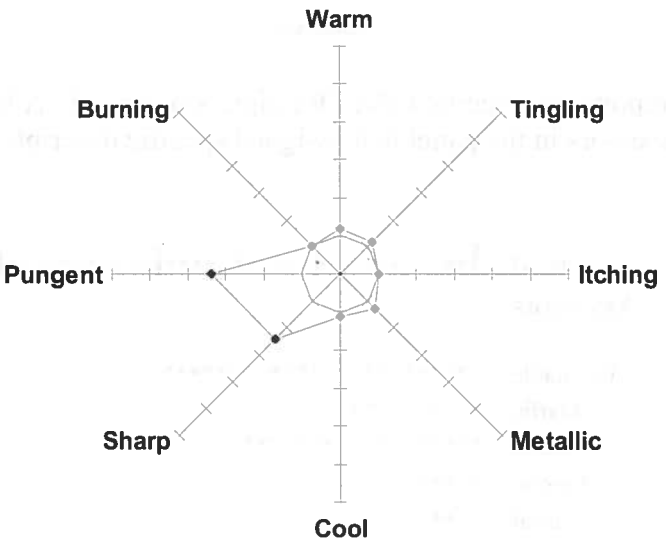
Each assessor also reports the specific Odor Descriptors observed. A histogram presents the percentage of assessors in the panel that assigned specific descriptors to the odor sample.

% of Assessors	|**********|**********|**********|**********| 100%
Vegetable	**********
Garlic	**********
Onion	**********
Lemon	*****
Floral	*****
Medicinal	**********
Menthol	*****
Chemical	**********
Petroleum	**********
Turpentine	*****
Solvent	*****
Gasoline	*****
Sulfur	**********
Offensive	**********
Sewer	*****
Garbage	*****
Rotten eggs	**********
Decay	*****
Putrid	*****
Earthy	*****
Musty	*****

Sensation Descriptors

The Trigeminal Nerves (Fifth Cranial Nerve), located throughout the nasal cavity and in the upper palate, and the other nerves in these areas sense the presence of some odors (i.e. "feels like…" rather than "smells like…"). Eight (8) common *sensation descriptors* that can be reported include: **Itching, Tingling, Warm, Burning, Pungent, Sharp, Cool, and Metallic**. Each assessor rates each of these sensations on a relative strength scale of zero to five, where zero is "not present", 1 = faint, 3 = moderate, and 5 = strong. The average results of the panel of assessors are plotted on a spider graph (polar plot). The axis on the spider graph, for example in the direction of **Burning**, is the relative strength scale.

Sensation Descriptor Graph



St. Croix Sensory technical staff works closely with our clients to discuss the specific odor evaluation needs of each project to provide valuable results.